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ABSTRACT

These teacher's materials are for a 19-unit competency-based course on entry-level motorcycle mechanics at the secondary and postsecondary levels. The 19 units are: (1) introduction to motorcycle repair; (2) general safety; (3) tools and equipment; (4) metric measurements; (5) fasteners; (6) service department operations; (7) motorcycle engines; (8) battery and electrical service; (9) carburetion and fuel systems; (10) wheels and tires; (11) steering and suspension; (12) brakes; (13) clutches; (14) starting systems; (15) basic ignition tune-up; (16) basic engine tune-up; (17) basic chassis tune-up; (18) assembly and predelivery; and (19) one-cylinder engine top-end service. The first section is designed to show teachers how to use the materials and includes an explanation of instructional elements, an instructional task analysis for each unit; a list of tools, equipment, and materials; and a list of 25 references. The instructional elements for the units include objectives, suggested activities, information sheets, transparency masters, assignment sheets, answers to assignment sheets, job sheets, tests, and test answers. Some elements, such as the information sheets, include photographs, diagrams, and line drawings. (CML)

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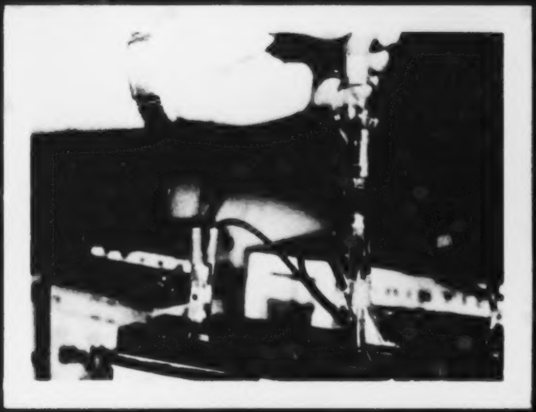

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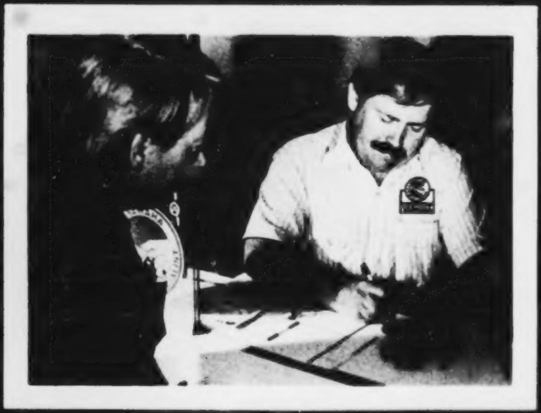

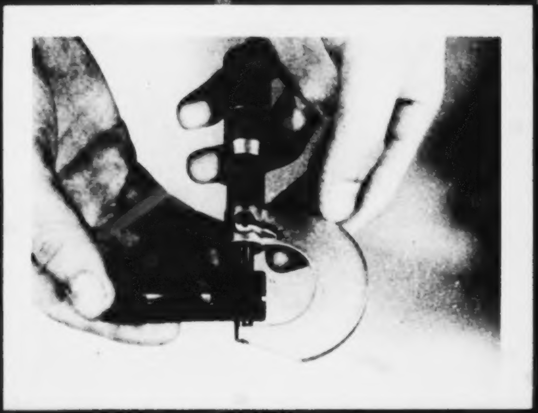

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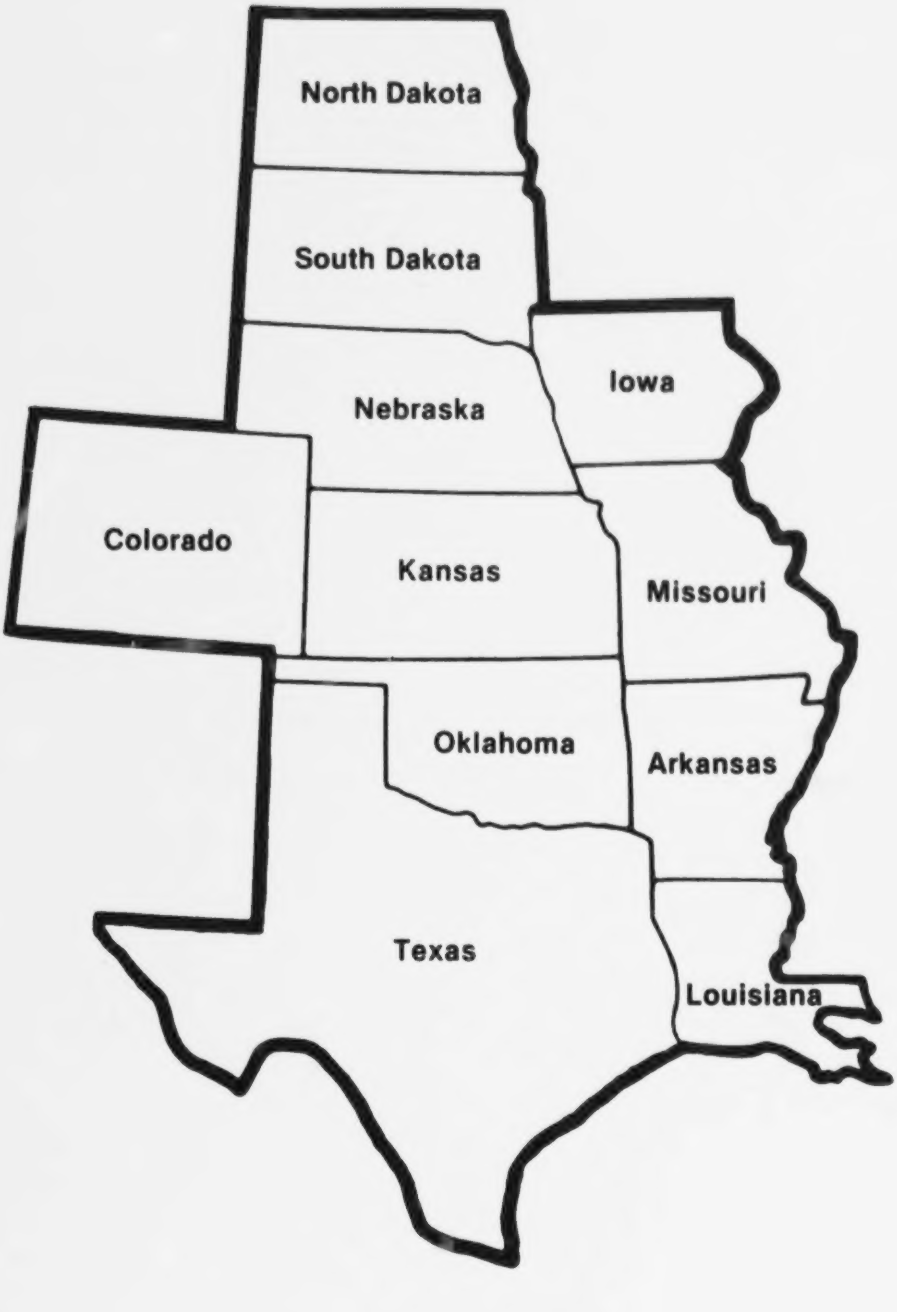
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MOTORCYCLE MECHANIC

Written by

Mickey Baugus

Edited by

Dan Fulkerson

Developed by

The Mid-America Vocational Curriculum Consortium, Inc.

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MOTORCYCLE MECHANIC

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FOREWORD

Should *Motorcycle Mechanic* become an award winning book, it wouldn't surprise us. You see, Mickey Baugus, the writer, is used to awards — and impressive ones at that! Mickey's motorcycle repair program at Central Vo-Tech in Drumright, Oklahoma, won the Secretary of Education's award for being the outstanding vocational program in America! The award, from the office of then Secretary of Education, the honorable T.H. Bell, was presented to Mickey at an all-school advisory committee meeting in 1983.

The Secretary of Education's Award brought national attention. In 1984, Mr. Tetsuo Chino, President of American Honda, visited Central Area Vo-Tech to personally congratulate Mickey Baugus, and to announce Honda's donation of six million dollars worth of motorcycles and equipment to American vocational education programs, a milestone in vo-tech history.

We feel that Mickey's award winning abilities are evidenced in the pages of this text. The entry-level skills presented here follow the same guidelines that Mickey emphasizes in Central Vo-Tech's motorcycle repair program. They are the same entry-level skills endorsed by Mickey's advisory committee, and for all these reasons, we feel that *Motorcycle Mechanic* will provide a utilitarian curriculuim for motorcycle repair programs everywhere — and turn them into winners.

Harley Schlichting, Chairman
Board of Directors
Mid-America Vocational
Curriculum Consortium

PREFACE

When we speak of "entry-level" skills in motorcycle repair, we are talking about job getting skills. These skills include tire and wheel service, assembly and set-up service, and battery service, and a reminder that an entry-level technician will probably have to sweep the parking lot every now and then.

As motorcycle dealerships expand into all terrain vehicles, lawn and garden equipment, and powered watercraft, the opportunities for motorcycle mechanics takes on new horizons. *Motorcycle Mechanic* offers the basics that a beginner needs to get a job along with the solid foundation required to turn a job into a career.

We might remind you also that *Motorcycle Mechanic* is part of MAVCC's impressive small engine repair series which includes *Small Engine Repair: Two-Stroke and Four-Stroke Cycle, Chain Saw Repair, Outdoor Power Equipment Repair, Outboard Repair,* and *Snowmobile Repair.* The books are all competency-based, and have become classroom favorites across the country. Keep MAVCC in mind for outstanding program materials.

Greg Pierce
Executive Director
Mid-America Vocational
Curriculum Consortium

ACKNOWLEDGEMENTS

The Resource Committee which planned and approved *Motorcycle Mechanic* was comprised of a choice selection of outstanding motorcycle repair instructors and an impressive group of national service representatives from the well-known major motorcycle manufacturers. The group also included owners of motorcycle dealerships, and we feel the expertise of that impressive committee helped make the text an outstanding one. To the Resource Committee, we extend a special thank you:

Mike Emberty	Fort Collins Cycle Center, Fort Collins, Colorado
Kenneth Powers	Vocational Curriculum Development and Research Center, Natchitoches, Louisiana
Al Goslee	Southeast Community College, Lincoln, Nebraska
John Shedd	Holmes High School, San Antonio, Texas
Randy Lowe	Indian Capital Area Vo-Tech School, Sallisaw, Oklahoma
Jerry Johnson	Suzuki Motors, Dallas, Texas
Lyle Sweeter	American Honda Motor Company, Gardena, California
Kevin Hartley	American Honda Motor Company, Irving, Texas
Ken Lizotte	Kawasaki Motors Corporation, U.S.A., Irvine, California
Norm McDonald	K & N Motorcycles, Tulsa, Oklahoma
Mickey Baugus	Central Area Vo-Tech School, Drumright, Oklahoma

Another special thank you goes to Dennis Hendrix of Yamaha, and to Donald Church and Ken Lizotte of Kawasaki for permission to reprint certain graphic materials that serve to enhance this text. And for their special interest, another vote of thanks goes to Kevin Hartley from the Honda Training Center in Dallas, and to Mike Baugus who contributed time to assist with photographs.

We thank the project editor, Dan Fulkerson, for doubling as photograher for the project, and the writer, Mickey Baugus, who also served as a valuable member of the Resource Committee.

Many of the photographs for the text were made in the motorcycle repair shop at Central Area Vo-Tech in Drumright, Oklahoma. To the many students who helped with many of the photographs, a special thank you. And the same holds true for Norm and Lucy McDonald of K & N Motorcycles in Tulsa. They and their staff helped significantly with many of the photographs, and we thank them for their hospitality.

The text was phototypeset by Leslie Mathis of the Graphics Department at Oklahoma State Vo-Tech, and the text was printed at the print shop of the Oklahoma State Department of Vocational-Technical Education. To Graphics and Print Shop personnel, a thank you for a job well done.

USE OF THIS PUBLICATION

Instructional Units

Motorcycle Mechanic contains nineteen units. Each instructional unit includes some or all of the basic components of a unit of instruction; performance objectives, suggested activities for teachers and students, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the tests. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help to determine:

A. The amount of material that can be covered in each class period
B. The skills which must be demonstrated

    1. Supplies needed
    2. Equipment needed
    3. Amount of practice needed
    4. Amount of class time needed for demonstrations

C. Supplementary materials such as pamphlets or filmstrips that must be ordered
D. Resource people who must be contacted

Objectives

Each unit of instruction is based on performance objectives. These objectives state the goals of the course, thus providing a sense of direction and accomplishment for the student.

Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of the students and community. When teachers add objectives, they should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

Suggested Activities for the Instructor

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. Duties of instructors will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheet, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss unit and specific objectives and information sheet; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Information Sheets

Information sheets provide content essential for meeting the cognitive (knowledge) objectives in the unit. The teacher will find that the information sheets serve as an excellent guide for presenting the background knowledge necessary to develop the skill specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

Assignment Sheets

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge which is a necessary prerequisite to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

Job Sheets

Job sheets are an important segment of each unit. The instructor should be able to demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for students to follow if they have missed a demonstration. Job sheets also furnish potential employers with a picture of the skills being taught and the performances which might reasonably be expected from a person who has had this training.

Practical Tests

Practical tests provide the instructor with an evaluation tool to aid with the documentation of student progress. The tests provide a brief but effective means to determine a student's ability to perform with tools and materials in performing a hands-on process or producing a product — a vital aid for pinpointing specific areas where students need additional instruction.

Test and Evaluation

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Test items for objectives added by the teacher should be constructed and added to the test.

Test Answers

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

MOTORCYCLE MECHANIC

INSTRUCTIONAL TASK ANALYSIS

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)

RELATED INFORMATION: What the Worker Should Know (Cognitive)

UNIT I: INTRODUCTION TO MOTORCYCLE REPAIR

1. Terms and definitions
2. Occupational outlook for motorcycle technicians
3. Career opportunities
4. Working conditions
5. Prerequisites recommended for motorcycle technicians
6. Advancement opportunities
7. Entry-level job assignments
8. Entry-level service responsibilities
9. Customer relations
10. Keys to advancement
11. Evaluate your potential as a motorcycle repair technician. (Assignment Sheet #1)
12. Visit a motorcycle dealership and make written reports about functions of various departments. (Assignment Sheet #2)

UNIT II: GENERAL SAFETY

1. Terms and definitions
2. Benefits of safe working practices
3. Major causes of accidents
4. Rules for good housekeeping
5. Basic rules for safe use of tools and equipment

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)

RELATED INFORMATION: What the Worker Should Know (Cognitive)

6. Safe lifting
7. Requirements for test riding
8. Fire safety
9. Special hazards with welding equipment
10. Classes of fires and their causes
11. Fire extinguisher requirements
12. Battery safety
13. Fuel, solvent, and chemical hazards
14. Special hazards with carburetor cleaner
15. Electrical safety
16. Ways to recognize shock
17. Steps in treating shock
18. First aid guidelines for common workplace injuries
19. First aid guidelines for workplace burns
20. Steps in controlling bleeding
21. Pressure points for checking bleeding
22. First aid for eye injuries
23. General guidelines for first aid emergencies
24. Special rules for eye protection
25. Special rules for using compressed air

26. Complete a student safety pledge. (Assignment Sheet #1)
27. Draw a floor plan and locate safety equipment in your shop. (Assignment Sheet #2)

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)

UNIT III: TOOLS AND EQUIPMENT

1. Terms and definitions
2. Basic hand tools
3. Special tools and their uses
4. Wheel and tire service equipment
5. Major equipment
6. General shop tools
7. Tools and equipment care and safety
8. Identify selected hand tools. (Assignment Sheet #1)
9. Identify selected major equipment. (Assignment Sheet #2)
10. Identify selected general shop tools. (Assignment Sheet #3)

UNIT IV: METRIC MEASUREMENTS

1. Terms and definitions
2. Metric measurements
3. Metric prefixes
4. Units of metric measurement
5. Metric measuring instruments
6. Using a metric outside micrometer
7. Reading a metric micrometer
8. Using a telescoping gauge
9. Using a small bore gauge
10. Using a dial bore gauge
11. Using vernier or dial calipers
12. Using a dial indicator

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)

RELATED INFORMATION: What the Worker Should Know (Cognitive)

13. Read a metric micrometer. (Assignment Sheet #1)

14. Measure selected workpieces with a vernier caliper. (Job Sheet #1)

15. Measure selected workpieces with a metric micrometer. (Job Sheet #2)

16. Measure runout and verify timing with a dial indicator. (Job Sheet #3)

17. Measure a cylinder bore with a telescoping gauge. (Job Sheet #4)

18. Measure selected workpieces with a small bore gauge. (Job Sheet #5)

UNIT V: FASTENERS

1. Terms and definitions
2. Metric bolts and nuts
3. Metric bolts and threads
4. Qualities of satisfactory fasteners
5. Typical fasteners
6. Typical bolt head styles
7. Typical nuts
8. Special purpose nuts with locking or self-locking features
9. Types of washers
10. Devices for locking nuts or bolts
11. Types of screw head designs
12. Types of snap rings
13. Special fasteners
14. Methods used to remove seized nuts

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	15. Repairing threads
	16. Adhesives and sealers
	17. Loosening and tightening fasteners
18. Draw the tightening sequence and list torque values for a selected component from a service manual. (Assignment Sheet #1)	
19. Repair damaged threads using a thread repair kit. (Job Sheet #1)	
20. Remove a broken bolt using a screw extractor set. (Job Sheet #2)	

UNIT VI: SERVICE DEPARTMENT OPERATIONS

	1. Terms and definitions
	2. How a service department is organized
	3. Service manager duties
	4. Service department technician duties
	5. Repair orders
	6. Service publications
	7. Guidelines for using a service manual effectively
	8. Guidelines for using a flat rate manual effectively
	9. Sources of other service information
	10. Other service department sales
11. Fill out a repair order properly. (Assignment Sheet #1)	

JOB TRAINING: What the
Worker Should Be Able to Do
(Psychomotor)

RELATED INFORMATION: What
the Worker Should Know
(Cognitive)

UNIT VII: MOTORCYCLE ENGINES

1. Terms and definitions
2. Basic motorcycle engine theory
3. Piston movement terms and their definitions
4. Two-stroke and four-stroke operations
5. Components of a four-stroke engine and their functions
6. Components of a two-stroke engine and their functions
7. Steps in the operation of a four-stroke engine
8. Steps in the operation of a two-stroke engine
9. Four-stroke engine characteristics
10. Two-stroke engine characteristics
11. Problems that cause poor engine performance
12. Tools required for basic engine troubleshooting
13. Troubleshoot a no-start complaint on a one-cylinder motorcycle engine. (Job Sheet #1)
14. Perform a leak-down test on a one-cylinder motorcycle engine. (Job Sheet #2)

UNIT VIII: BATTERY AND ELECTRICAL SERVICE

1. Terms and definitions
2. Batteries

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	3. Battery safety
	4. Battery identification
	5. Battery maintenance
	6. Hydrometers
	7. Electrical circuits
	8. Systematic electrical troubleshooting
	9. Test light troubleshooting
	10. Voltmeter use
	11. Types of splices
12. Trace a motorcycle brake light circuit on a wiring diagram. (Assignment Sheet #1)	
13. Service and charge a new motorcycle battery. (Job Sheet #1)	
14. Remove, clean, service, and install a motorcycle battery. (Job Sheet #2)	
15. Check the output of a charging system. (Job Sheet #3)	
16. Use a test light to verify voltage. (Job Sheet #4)	
17. Splice and solder electrical wires. (Job Sheet #5)	

UNIT IX: CARBURETORS AND FUEL SYSTEMS

	1. Terms and definitions
	2. Carburetor operation
	3. Parts of a carburetor
	4. Air-fuel ratios

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	5. Carburetor circuits and their general functions
	6. Float circuit components and operations
	7. Low-speed circuit components and operations
	8. Transition circuit components and operations
	9. Mid-range circuit components and operations
	10. High-speed circuit components and operations
	11. Enrichener circuit components and operations
	12. Interrelationship of carburetor circuits
13. Remove, disassemble, clean, reassemble, and install a one-cylinder motorcycle carburetor. (Job Sheet #1)	
14. Remove, clean, and install a fuel valve. (Job Sheet #2)	

UNIT X: WHEELS AND TIRES

1. Terms and definitions
2. Types of wheels
3. Parts of a tire
4. Tire tools and equipment
5. Other supplies required for tire repair
6. Tire markings
7. Valve stems and valve caps
8. Tubeless tire repair

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	9. Tire liabilities
	10. Spoke and rim terms
	11. Wheel trueing terms
	12. Spoke patterns
	13. Guidelines for spoking and trueing wheels
	14. ATV tires
	15. Personal safety around wheels and tires
16. Remove, replace/repair, and install a front tire and wheel assembly on a motorcycle. (Job Sheet #1)	
17. Remove, replace/repair, and install a rear tire and wheel assembly on a motorcycle. (Job Sheet #2)	
18. Replace a damaged rim and respoke and true a motorcycle wheel. (Job Sheet #3)	
19. Remove, replace/repair, and install a tire on an ATV. (Job Sheet #4)	
20. Make inside and outside repairs on ATV tires. (Job Sheet #5)	

UNIT XI: STEERING AND SUSPENSION

	1. Terms and definitions
	2. Front fork components
	3. Front fork fluid
	4. Steering head bearings
	5. Swing arm pivot assemblies
	6. Sprockets and chain drives

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	7. Belt drives
	8. Drive shafts
9. Change oil in a front fork. (Job Sheet #1)	
10. Replace front fork seals. (Job Sheet #2)	
11. Change final drive oil. (Job Sheet #3)	
12. Inspect and replace drive chain and sprockets. (Job Sheet #4)	
13. Inspect and adjust steering head bearings. (Job Sheet #5)	

UNIT XII: BRAKES

	1. Terms and definitions
	2. Types of brake systems
	3. How a mechanical brake system works
	4. How a hydraulic brake system works
	5. Brake drum wear
	6. Brake fluid
	7. Brake bleeding
8. Inspect brake shoes and brake pads for wear. (Job Sheet #1)	
9. Replace brake shoes on a drum-type brake and adjust the brake. (Job Sheet #2)	
10. Replace brake pads on a disc system. (Job Sheet #3)	
11. Bleed a hydraulic brake system (Job Sheet #4)	

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)

UNIT XIII: CLUTCHES

1. Terms and definitions
2. Major clutch parts
3. Clutch operations
4. Clutch discs and plates
5. Other clutch parts
6. Guidelines for clutch service
7. Remove, disassemble, inspect, and reassemble a motorcycle clutch. (Job Sheet #1)

UNIT XIV: STARTING SYSTEMS

1. Terms and definitions
2. Kick starters
3. Electric starters
4. Recoil starters
5. Service a recoil starter. (Job Sheet #1)

UNIT XV: BASIC IGNITION TUNE-UP

1. Terms and definitions
2. Electronic ignition systems
3. Breaker-point ignition systems
4. Energy transfer ignition systems
5. Guidelines for ignitions service
6. Service a breaker-point ignition system. (Job Sheet #1)

JOB TRAINING: What the
Worker Should Be Able to Do
(Psychomotor)

RELATED INFORMATION: What
the Worker Should Know
(Cognitive)

UNIT XVI: BASIC ENGINE TUNE-UP

1. Terms and definitions
2. Engine tune-up preparations
3. Engine tune-up sequence
4. Spark plug inspection
5. Valve adjustment
6. Cam chain adjustment
7. Ignition timing
8. Ignition timing marks
9. Air filter service
10. Crankcase ventilation
11. Carburetor adjustment
12. Carburetor synchronization
13. Oil and filter service
14. Select proper shim thicknesses for shim-type valve adjustment. (Assignment Sheet #1)
15. Perform a compression test on a motorcycle engine. (Job Sheet #1)
16. Perform a leak-down test on a motorcycle engine. (Job Sheet #2)
17. Adjust the valves on a motorcycle engine. (Job Sheet #3)
18. Adjust cam chain tension. (Job Sheet #4)
19. Inspect ignition timing. (Job Sheet #5)
20. Service an air filter. (Job Sheet #6)
21. Adjust a motorcycle carburetor using an exhaust gas analyzer. (Job Sheet #7)
22. Synchronizes carburetors on a multi-cylinder motorcycle engine. (Job Sheet #8)
23. Change engine oil and filter. (Job Sheet #9)

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)

UNIT XVII: BASIC CHASSIS TUNE-UP

	1. Terms and definitions
	2. Guidelines for chassis tune-up
	3. Control cables
	4. Detailing
5. Remove, lubricate, and replace control cables. (Job Sheet #1)	
6. Detail a motorcycle or an ATV. (Job Sheet #2)	

UNIT XVIII: ASSEMBLY AND PRE-DELIVERY

	1. Terms and definitions
	2. Receiving a new vehicle
	3. Guidelines for uncrating
	4. Guidelines for assembly
	5. Guidelines for preparing a new vehicle for delivery
	6. Guidelines for test riding a new vehicle
7. Uncrate a new motorcycle and prepare it for assembly. (Job Sheet #1)	
8. Assemble a new vehicle. (Job Sheet #2)	
9. Prepare a new motorcycle for delivery. (Job Sheet #3)	

JOB TRAINING: What the
Worker Should Be Able to Do
(Psychomotor)

RELATED INFORMATION: What
the Worker Should Know
(Cognitive)

UNIT XIX: ONE-CYLINDER TOP-END SERVICE

1. Terms and definitions
2. Components of a two-stroke top end
3. Components of a four-stroke top end
4. Four-stroke cylinder head
5. Two-stroke piston
6. Four-stroke piston
7. Parts of a valve
8. Guidelines for cleaning top-end components
9. Guidelines for measuring a cylinder
10. Guidelines for measuring a piston
11. Two-stroke piston rings
12. Guidelines for installing two-stroke rings
13. Four-stroke piston rings
14. Special tools and materials for top-end service
15. Ring installation
16. Safety guidelines for top-end service
17. Read and interpret wear limit information from a service manual. (Assignment Sheet #1)
18. Disassemble, inspect, and reassemble a two-stroke motorcycle engine. (Job Sheet #1)
19. Disassemble, inspect, and reassemble a four-stroke motorcycle engine. (Job Sheet #2)

MOTORCYCLE MECHANIC

Tools, Equipment, and Materials List

Basic hand tools

Flat blade and Phillips screwdrivers
Impact driver and socket for Phillips-head screws
Combination wrench set
Minimum clearance shallow and deep socket sets
Ratchet and extensions
Combination slip-joint pliers
Needlenose pliers
Putty knife or gasket scraper
Feeler gauge set
Magnetic screw starter
Metric allen wrench set
Hammer
Soft-faced mallet
Files
Chisels
Punches
Hacksaw
Pneumatic ratchet and impact gun

Special tools

Pullers
Torque wrench
Installers
Holders
Protectors
Gauges
Adapters
Adjustors
Compressors

Wheel and tire service equipment

Tire changer
Wheel balancer
Trueing stand
Tire tools

Major equipment

Boring bar
Cylinder hones
Die-grinder
Bench grinder
Motorcycle lift(s)
Large fan
Valve reconditioning tools
Glass bead cleaning machine
Solvent cleaning station
Press
Drill press
Crankshaft trueing stand

General shop tools

Bench vises
Oxyacetylene cutting equipment

Materials

Lubricants
Sealers
Gasket material
High temperature grease

Housekeeping items

Drain pans
Funnels
Brooms
Mops
Degreaser
Floor cleaner

ALPHABETICAL LIST OF REFERENCES USED IN DEVELOPING THIS TEXT

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B. *CC Specialty* (catalog). Lawrenceburg, TN 38464: CC Specialty Co., 1985.

C. *Dictionary of Occupational Titles.* Fourth edition. Washington, D.C. 20402: U.S. Department of Labor, Employment and Training Administration, 1977.

D. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics.* New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

E. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

F. Henderson, John M.D. *Emergency Medical Guide.* New York, NY: McGraw-Hill, 1968.

G. Hires, Bill, Mark Taylor, and Mike BUndy. *Small Engine Repair Two-Stroke and Four-Stroke Cycle.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1985.

H. *Honda Pro Training Reference Materials,* (Engine Service). Gardena, CA 90247: American Honda Motor Co., Inc., 1984.

I. Johns, Bruce A., and David D. Edmundson. *Motorcycles Fundamentals, Service, Repair.* South Holland, IL: The Goodheart-Willcox Co., Inc., 1984.

J. *Kansas Safety Education Handbook, Volume III.* Wichita, KS: Kansas State Department of Education in cooperation with the Wichita Public Schools, U.S.D. 259, 1981.

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L. *Kidde Portable Extinguishers, The ABC's of Fire Prevention.* Belleville, NJ: Walter Kidde & Co., Inc., 1978.

M. *KOWA SEIKI Precision Tools and Equipment* (catalog). Carson, CA 90746: American Kowa Seiki, Inc., 1986.

N. *Motorcycle Fuel and Induction Systems.* Gardena, CA: American Honda Motor Co., Inc., 1986.

O. *Motorcycle Technical Training Centers Technician's Handbook.* Cypress, CA Yamaha International Corporation, 1979.

P. *Official Honda Shop Manual '78-81 CB/CM400's.* Gardena, CA: Honda Motor Co., Ltd., 1980.

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T. The American Red Cross. *Standard First Aid and Personal Safety.* Garden City, NJ: Doubleday and Co., Inc., 1978.

U. *Training Reference Materials.* Gardena, CA: American Honda Motor Co., Inc., 1985.

V. *VoTech HONDA.* Gardena, CA 90247: American Honda Motor Co., Inc., 1983.

W. *Yamaha Motorcycle Tri-Moto/Generator Special Service Tools* (catalog). Roseville, MI 48066-2298: Kent-Moore Tool Division, 1983.

X. *1987 Yuasa Motorcycle and ATV Battery Specifications and Applications.* Reading, PA 19603: Yuasa General Battery Corporation, 1987.

INTRODUCTION TO MOTORCYCLE REPAIR

UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss career opportunities, working conditions, and entry-level job assignments for motorcycle repair technicians. The student should also be able to list keys to advancement, evaluate personal potential as a repair technician, and report on department functions in a dealership. These competencies will be evidenced by correctly performing the procedures outlined in the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to introduction to motorcycle repair with their correct definitions.
2. Complete statements concerning the occupational outlook for motorcycle technicians.
3. Select true statements concerning career opportunities.
4. Complete statements concerning working conditions.
5. List prerequisites recommended for motorcycle technicians.
6. Match advancement opportunities with their job descriptions.
7. Complete statements concerning entry-level job assignments.
8. Complete statements concerning other entry-level service responsibilities.
9. Solve problems concerning customer relations.
10. Complete statements concerning keys to advancement.
11. Evaluate your potential as a motorcycle repair technician. (Assignment Sheet #1)
12. Visit a motorcycle dealership and make written reports about functions of various departments. (Assignment Sheet #2)

INTRODUCTION TO MOTORCYCLE REPAIR
UNIT I

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information and assignment sheets.

C. Discuss unit and specific objectives.

D. Discuss information sheet.

E. Invite a local or area dealer to talk to the class about expanding product lines such as outboard motors, lawn mowers, and other power equipment, and ask the dealer to address the problems and opportunities the product expansion poses for the repair technician.

F. Invite a factory representative to talk to the class about the motorcycle industry in general and about other jobs at the manufacturing level.

G. Make a telephone survey of dealerships in your area, and prepare a list of people who buy motorcycles to determine if the average bike buyer today is older than the bike buyers of years past.

H. Read the assignment sheets carefully, and make specific dates and times for students to visit a dealership so they can complete the reports required in Assignment Sheet #2.

I. Review the nature of the other units in this text and arrange for appropriate audio visual materials to reinforce the units of instruction. Some specific items that are available appear in the "Suggested Activities" of the units to which they apply, but general information about video materials is available from many sources, including:

American Honda Motor Co., Inc.
Motorycle VoTech
100 West Alondra Blvd.
Gardena, CA 90248-2702

Kawasaki Motors Corp., U.S.A.
Technical Training Department
9950 Jeronimo Road
Irvine, CA 92718-2016

Yahama Motor Corporation, U.S.A.
Training Department
6555 Katelle Avenue
Cypress, CA 90630

J. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Hires, Bill, Mark Taylor, and Mike Bundy. *Small Engine Repair Two-Stroke and Four-Stroke Cycle.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1985.

C. *Dictionary of Occupational Titles.* Fourth edition. Washington, D.C. 20402: U.S. Department of Labor, Employment and Training Administration, 1977.

INTRODUCTION TO MOTORCYCLE REPAIR
UNIT I

INFORMATION SHEET

I. **Terms and definitions**

A. ATV (all terrain vehicles) — A general group of 3-wheel and 4-wheel vehicles designed for both recreation and utility use

B. Customer relations — That part of a business that relies on individual attitudes and actions to inspire trust and confidence in customers

C. Dealership — A business dedicated to selling and servicing motorcycles and other products

D. Etiquette — The accepted manner in which to politely conduct social and business activities

E. EPA (Environmental Protection Agency) — A federal agency that sets limits for the amounts of hydrocarbons and other pollutants that can be legally exhausted by an engine

F. Parts Department — That part of a dealership that manages the inventory of replacement parts and accessories

G. Prerequisites — The practical and academic experiences that must be completed before a higher level of skills development can begin

H. Public relations — The process of promoting an attractive business image through advertising and through participation in public events that permit display of the company name and products

I. Sales Department — That part of a dealership that manages the sales of new and used motorcycles, ATV's, and other vehicles or equipment in a product line

J. Service Department — That part of a dealership that takes care of all warranty work and otherwise performs maintenance, service, and repairs as required

II. **Occupational outlook for motorcycle technicians**

A. The demand for motorcycle technicians will continue to grow into the next century.

B. Recent statistics indicate approximately 850 registered motorcycles for each motorcycle technician, and this indicates a need for more entry-level technicians.

(NOTE: The 850 to 1 ratio becomes especially significant when compared with the automotive industry where there is approximately 1 mechanic for every 300 cars.)

INFORMATION SHEET

C. An increase in the young adult population with higher personal incomes will continue to increase the demand for motorcycles, scooters, and three and four-wheel all terrain vehicles. (Figure 1)

FIGURE 1

D. An increase in motorcycle ownership among older age groups and senior citizens will help increase the need for technicians.

E. Jet skis and similar gasoline-powered watercraft have also added to the demand for technicians.

F. Gasoline-powered golf carts provide another service need and source of future technician employment.

G. Past motorcycle designs afforded owners with opportunities for many do-it-yourself repairs, but the complexity of modern motorcycles demands professional repair.

H. As dealerships expand to include lines of power equipment such as generators, water pumps, lawn mowers, and snow blowers, the need for technicians to repair them will also increase.

I. As motorcycle manufacturers move into production of outboard engines, another service area will be created.

III. **Career opportunities**

A. An entry-level motorcycle technician will average more than 5 dollars per hour, and experienced technicians earn 10 to 15 dollars an hour.

B. Some technicians are paid on a commission basis which usually gives them 40 percent of the labor charged the customer.

C. The commission system inspires speed and quality workmanship and rewards the professional technician, especially during peak seasons.

(NOTE: To succeed on the commission system, one must be a trained professional because improper repairs that have to be redone are at the expense of the technician's time.)

INFORMATION SHEET

D. Experienced technicians with leadership capabilities often advance to management positions.

IV. **Working conditions**

A. Motorcycle repair shops are usually well-lighted, well ventilated, and climate-controlled for technician comfort.

B. The days of the loud motorcycle have passed and repair shops are no longer the noisy places they used to be when engines were being tested.

(NOTE: Most modern motorcycles are well below the noise emission standards set by the EPA.)

C. Employees in most motorcycle repair facilities develop close personal and professional ties and frequently join together to enjoy races, rallies, and other after work activities.

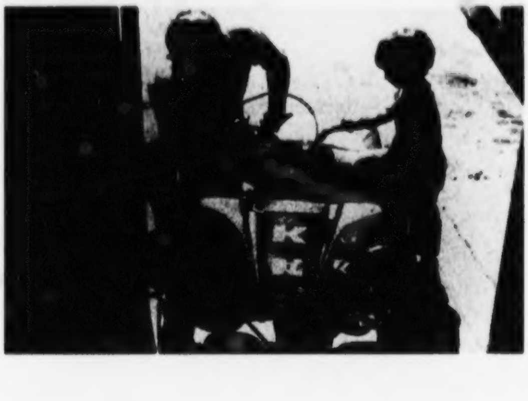
D. The demand for motorcycle service is highest in the warm weather months, and during peak periods technicians may work overtime frequently.

E. Although motorcycling is seasonal in some northern areas, the repairs of ATV's, winter recreational vehicles, and snow blowers alleviates off-season declines.

F. Many dealerships offer fringe benefits ranging from life and health insurance to paid vacations, and dealer-sponsored trips to races, rallies, and service schools.

G. As dealerships expand product lines, technicians have to continue improving skills because the next repair work may be a lawn mower, and a well rounded technician should be able to work on anything that comes in the door. (Figure 2)

FIGURE 2



INFORMATION SHEET

V. **Prerequisites recommended for motorcycle technicians**

A. An interest in science and mathematics is beneficial to a potential motorcycle technician.

B. Persons who have studied small engine repair or auto mechanics are well prepared to enter motorcycle repair programs.

C. People who own their own motorcycles and have had practical experience in service and repair usually make good technicians.

D. Employers prefer that entry-level technicians have a high school education.

E. The ability to read and comprehend service manuals and other technical materials is vital to the success of a technician.

VI. **Advancement opportunities and their job descriptions**

A. Service writer — Writes work orders, makes repair estimates, but most of all is the professional that alerts customers to repairs necessary for bike safety or performance

B. Service manager — Coordinates all service work, makes sure necessary parts are available for repair work, assists technicians with difficult jobs, schedules set-up of new units with sales needs, and orients new customers to bike safety and maintenance requirements (Figure 3)

FIGURE 3

INFORMATION SHEET

C. General manager — Responsible for the overall operation of a dealership including ordering new bikes, keeping proper inventory, checking paperwork from shop to front office, and generally looking after the public relations and promotional activities of the business (Figure 4)

FIGURE 4

D. Factory rep — Works as a representative of a motorcycle manufacturer to insure that dealerships are taking advantage of manufacturer's professional assistance with sales, service, and general operations

(NOTE: Industry almost always promotes from its own ranks, and more than 80 percent of factory reps and other technical service people come from local dealerships.)

E. Shop or Dealership owner — Manages, buys, sells, hires, fires, and generally does everything necessary to keep customers happy and maintain a healthy business (Figure 5)

FIGURE 5

F. Vocational instructor — Teaches motorcycle service and repair to students interested in becoming professional motorcycle technicians

INFORMATION SHEET

VII. **Entry-level positions**

A. Entry-level technicians seldom work in the sales or parts department. (Figure 6)

FIGURE 6

B. Entry-level technicians almost always start work in the service department.

C. Entry-level technicians usually work in the service department's two most important areas:

1. Tire service (Figure 7)

(NOTE: This includes changing/repairing not only motorcycle tires, but ATV tires too, and it's a major income area for a dealership.)

FIGURE 7

INFORMATION SHEET

2. Assembly and pre-delivery service (Figure 8)

   (NOTE: This activity starts with unloading a crated bike from a truck, uncrating the unit, assembling the unit, servicing the unit for delivery to a customer, and sometimes delivering the bike to the customer.)

FIGURE 8

D. Improper tire repair can result in customer injury and expensive liability suits against the company.

E. A bike improperly assembled or carelessly assembled will result in poor customer satisfaction, inspire bad word-of-mouth advertising, and could result in a liability suit against the company.

F. In short, although entry-level technicians repair tires and set up bikes, the two areas are critical to success of the dealership and are very important jobs where good workmanship will be noticed.

VIII. **Other entry-level service responsibilities**

A. There are many specialized tools and major pieces of equipment in a service area, and beginning technicians must learn how to safely use and maintain the equipment and tools they must have to do their jobs.

B. Proper use of tools must be learned to avoid personal injury, but proper tool and equipment use also helps avoid damage to new units or to customer vehicles.

C. More than 95% of all motorcycles sold in America are manufactured with metric specifications, and technicians must know how to use metrics in service and repair activities.

D. Motorcycles are held together with an assortment of nuts, screws, bolts, clips, pins, and other devices known as fasteners, and a technician must develop skills in working with fasteners.

INFORMATION SHEET

E. As a member of the service department, a beginner will be called upon to handle paperwork properly, locate parts indexed on microfiche, talk with customers, and sometimes answer the phone or work at the cash register.

(NOTE: The more a beginner can do well, the more value he/she will be to a dealership because it frees other experienced technicians to continue with advanced repair activities that bring the dealership more dollars per hour.)

F. Entry-level technicians need to know 2-cycle and 4-cycle engine theory so they can develop the skills required for properly diagnosing engine problems.

G. Battery and electrical problems provide some of the biggest headaches in motorcycle repair, and the technician who develops skills in these areas will be of special value.

H. Beginning technicians also need service skills with brakes, clutches, suspensions, final drives, fuel systems, chassis service, wheel service and repair, and starting and charging systems.

I. Although tune-ups are usually performed by skilled technicians, beginners often get to work on smaller motors and should make an extra effort to develop good tune-up skills.

J. Entry-level technicians must never forget that as they learn new skills they are still expected to do some of the basic things a business requires, and that may include cleaning the parking lot and sweeping floors. (Figure 9)

FIGURE 9

IX. **Customer relations**

A. Entry-level technicians usually do not deal with customers on a regular basis, but they need to be able to talk intelligently with customers when they have to.

B. All customers should be greeted cordially and treated with respect.

INFORMATION SHEET

C. Many customers have difficulty talking about problems in specific technical terms and need to be treated with a great deal of patience.

D. Customers are sometimes upset and have to be handled tactfully and calmed down. (Figure 10)

FIGURE 10

E. Beginners in the business sometimes have to answer the phone and should know basic rules of telephone etiquette:

1. Identify the company, give your name, and ask, "May I help you?"
2. Take notes if you need to and be sure to have the customer repeat anything you don't understand.
3. When looking something up requires a great deal of time, remind the customer every now and then that you're still taking care of the problem.
4. Speak clearly and politely with a phone customer, and if you don't know the answer to a customer's question, give the call to someone who can help.
5. Conclude phone conversations on a positive note by thanking the customer for calling your place of business.

X. **Keys to advancement**

A. A good personal appearance and a professional attitude are the keys to advancement as a motorcycle repair technician.

B. Technicians who are sloppy, dirty, and poorly groomed inspire negative responses, and customers will not continue doing business where such people work.

INFORMATION SHEET

C. Technicians who are clean and well groomed inspire positive responses, and customers will continue doing business where these people work.

D. A professional attitude inspires good work habits such as getting to work on time and putting in a full day's work for a full day's pay.

E. Bikes were once sold to a predominantly young group, but the more mature group of people buying bikes today prefer technicians whose personal appearance reflects responsibility.

F. A professional attitude inspires good workmanship that customers appreciate and that the technician gets a personal reward from.

G. Even with good mechanical skills, a technician with poor personal appearance and a don't-care attitude will not last long in the motorcycle repair business.

H. Honesty is primary to success in all walks of life, and trustworthy technicians do not help themselves to spare parts or supplies without paying for them.

INTRODUCTION TO MOTORCYCLE REPAIR
UNIT I

ASSIGNMENT SHEET #1 — EVALUATE YOUR POTENTIAL AS A MOTORCYCLE REPAIR TECHNICIAN

Directions: Answer the following questions honestly. Enter a number or zero for each question, then total your score and record it as indicated. Your evaluation will not be seen by your instructor, but when it is completed, your instructor will interpret class scores generally so all class members will, so to speak, know the score.

1. a. How many times have you had your hair cut or styled in the past year? a.________

   b. How often do you take a bath or shower each week? b.________

   c. How often have you seen your dentist in the past two years? c.________

   d. How many new pieces of clothing, including shoes, have you acquired in the past year? d.________

   e. On a scale of 1 to 10, with 10 being the highest, how do you think you look when you're really dressed up? e.________

   TOTAL ALL ITEMS FROM QUESTION 1 AND ENTER HERE 1.________

2. a. How many jobs have you had that required you to greet or work with customers? a.________

   b. How often in the past year have you really lost your temper? b.________

   c. When you argue, give yourself a 1 if you think you argue intelligently, a 2 if you think you get too emotional when you argue, and a 3 if you really have fun arguing. c.________

   d. How many times in the past year have you helped an acquaintance, friend, or relative alleviate or solve some problem simply by talking with them? d.________

   e. If you were a baseball official, give yourself a 3 if you'd like to be a home-plate ump and call balls and strikes, a 2 if you'd like to be a first-base ump, and a 1 if you'd like to be a third-base ump. e.________

   TOTAL ALL ITEMS FROM QUESTION 2 AND ENTER HERE 2.________

ASSIGNMENT SHEET #1

3. a. When it comes to going out with a friend to a movie or any activity, give yourself a 2 if you usually initiate the action and a 1 if you usually respond to invitations from others who invite you to come along. a.________

b. How many times in the past year have you decided that something you use needed repairing and then fixed it yourself? b.________

c. How many times in the past year have you called somebody long distance just to surprise them? c.________

d. If there were a leaky faucet in your bathroom or kitchen, give yourself a 1 if you would call a plumber and have it repaired, a 2 if you would ask someone how to repair it, and then try to do it yourself, and a 3 if you would tackle the job all alone with no outside help. d.________

e. Imagine you are trying to convince your best friend that you are a "go getter." Give yourself a 1 if your friend would laugh hysterically, a 2 if your friend would simply change the subject, and a 3 if your friend would admit that it is a quality evident in your behavior. e.________

TOTAL ALL ITEMS FROM QUESTION 3 AND ENTER HERE 3.________

4. a. How many times in the past year have you been late to school, or if not in school, how many times late to work, or if not working, how many times late to anything? a.________

b. Remember a time when you were late to school or work and give yourself a 1 if you presented the teacher or boss with a lousy excuse that you know was not believed, a 2 if you presented an excuse that was mostly accepted, and a 3 if you came up with an absolute lie that they swallowed hook, line, and sinker. b.________

c. If you were going on a blind date, give yourself a 3 if you would dress up and be on time, a 2 if you would dress casually and be just a little late, or a 1 if you would pay no attention to how you dressed and show up late just to prove you're not too excited about the whole affair. c.________

d. Give yourself a 3 if you can come within a dollar of accounting for all the money you have spent in the past week, a 2 if you can come within five dollars, and a 1 if you think you'll miss the estimate by more than seven dollars. d.________

e. On a scale of 1 to 10, with 10 being the highest, how would your friends rate your dependability factor? e.________

TOTAL ALL ITEMS FROM QUESTION 4 AND ENTER HERE 4.________

TOTAL ITEMS 1, 2, 3, AND 4 AND ENTER HERE ________

INTRODUCTION TO MOTORCYCLE REPAIR
UNIT I

ASSIGNMENT SHEET #2 — VISIT A MOTORCYCLE DEALERSHIP AND MAKE WRITTEN REPORTS ABOUT FUNCTIONS OF VARIOUS DEPARTMENTS

Directions: Your instructor has arranged for the class to visit a motorcycle dealership in your area. Use the following forms to make notes about the activities you find in various departments of the dealership, and then complete a brief written report on each department.

Date of field trip: ________________________________

Name of dealership visited: ________________________________

Address of dealership: ________________________________

Name of owner or manager: ________________________________

Name of sales manager: ________________________________

Name of service manager: ________________________________

Name of parts manager: ________________________________

Total number of employees: ________________________________

Part 1— Business Overview

1. How many units does the dealership sell annually? ____________________
   a. Motorcycles ____________________
   b. ATV's ____________________
   c. Power equipment ____________________
   d. Marine craft ____________________
   e. Outboard motors ____________________
   f. Lawn and garden equipment ____________________
   g. Other types of equipment sold and numbers ____________________
   ____
2. What are the fringe benefits the dealership offers employees?
   ____
   ____

ASSIGNMENT SHEET #2

Part 2 — Parts Department

1. How many people work in the parts department? ______________________

2. List any special equipment the parts department requires to do its job properly.

____

____

3. What are the skills required to become a good parts person?

____

____

4. How does a good parts department manage inventory?

____

____

5. What's the biggest problem that a parts department deals with?

____

____

6. What is the general salary range of parts department personnel?

____

____

7. What are the job advancement opportunities for parts department employees?

____

____

8. List your personal opinions of parts department operations (is it well organized, is the space allotted for parts storage sufficient, and other items you deem important).

____

____

____

ASSIGNMENT SHEET #2

Part 3 — Service Department

1. How many people work in the service department? ____________________

2. List the major pieces of equipment that are required in a service department.

3. How many different jobs are performed in the service department?

4. What are the most frequent repair activities that the service department deals with (list the top three)?

5. What is the general salary range of service department technicians?

6. What are the job advancement opportunities for service department technicians?

7. If you were an employee in the service department, what improvements would you recommend or what changes would you make?

ASSIGNMENT SHEET #2

Part 4 — Sales Department

1. How many people work in the sales department? ________________________

2. How many new bikes are on display? ________________________

3. What other kinds of equipment are on display?

____

____

4. What do you see in the sales area that would attract customers and promote sales?

____

____

5. List any form of advertising (radio, TV, newspaper) that you have personally heard or seen that the dealership uses to promote sales or service.

____

____

6. What banners or displays are used to promote the product line, and what is your opinion of them?

____

____

7. What is the general salary range of sales people?

____

8. What are the job advancement opportunities for sales people?

____

____

9. How many of the sales people formerly worked in some other department of this dealership or another dealership, and what did they do?

____

10. If you had your pick of motorcycles on display, which one would you buy, and why that one?

____

____

ASSIGNMENT SHEET #2

Part 5 — Dealership Evaluation

1. What are the three outstanding features of the dealership?

___

___

___

2. Would you like to work at this dealership, and if so, why?

___

___

3. If you would not like to work at this dealership, explain why.

___

___

INTRODUCTION TO MOTORCYCLE REPAIR
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

1. The major objective to the evaluation is to determine the student's ability to read and follow directions carefully. As directions indicated, every item should be answered, items in each of the four sections should be subtotaled, and the grand total of items 1, 2, 3, and 4 should be the very last entry in the test. Any number left blank indicates a failure to follow instructions carefully.

   a. With the exception of 1c, all items not answered with a minimum of 6 indicates a need for improvement in personal appearance or habits that promote good personal appearance, and anything less than a 6 on 1e indicates problems in self-esteem. If the total score on item 1 is less than 30, it points to habits and attitudes that need to be improved.

   b. Anything less than a 5 as a total for item 2 indicates someone who may need to improve his or her verbal skills. A 3 as an answer to both 2c and 2e indicates good verbal skills and favorable self-esteem.

   c. Anything less than a 5 as a total for item 3 indicates a lack of initiative. At least a 1 in item 3c indicates a concern for people, a good quality, and 1 is the perfect answer for 3e since it indicates appreciation for honesty in personal relationships.

   d. Anything less than a 15 as a total for item 4 probably indicates a person who rationalizes too often, meaning that they may stretch the truth to justify attitudes or actions. A 2 on item 4b is the best answer because it indicates a flair for recognizing the difference between diplomacy and a white lie, and since 4c is not concerned with dependability at all, but one's attitude toward people in general, the best answer would be a 3. And 4d is a question which reinforces the fact that we forget quickly and stresses the need for writing things down.

   Anything less than a 55 as a total score indicates attitudes and habits that need attention and improvement. And finally, anyone who didn't laugh, chuckle, or smile while taking the ACID test may have sense-of-humor problems.

2. Evaluated to the satisfaction of the instructor.

INTRODUCTION TO MOTORCYCLE REPAIR
UNIT I

NAME ______________________

TEST

1. Match each term on the right with its correct definition.

_____a. A general group of 3-wheel and 4-wheel vehicles designed for both recreation and utility use

_____b. That part of a business that relies on individual attitudes and actions to inspire trust and confidence in customers

_____c. A business dedicated to selling and servicing motorcycles and other products

_____d. The accepted manner in which to politely conduct social and business activities

_____e. That part of a dealership that manages the inventory of replacement parts and accessories

_____f. The practical and academic experiences that must be completed before a higher level of skills development can begin

_____g. The process of promoting an attractive business image through advertising and through participation in public events that permit display of the company name and products

_____h. That part of a dealership that manages the sales of new and used motorcycles, ATV's, and other vehicles or equipment in a product line

_____i. That part of a dealership that takes care of all warranty work and otherwise performs maintenance, service, and repairs as required

_____j. A federal agency that sets limits for the amounts of hydrocarbons and other pollutants that can be legally exhausted by an engine

1. Prerequisites
2. Service Department
3. ATV's
4. Public relations
5. Etiquette
6. Dealership
7. Sales Department
8. Customer relations
9. Parts Department
10. EPA

TEST

2. Complete statements concerning the occupational outlook for motorcycle technicians by inserting the word(s) or number(s) that best completes each statement.

   a. The demand for motorcycle technicians will continue to ____________ into the next century.

   b. Recent statistics indicate approximately ____________ registered motorcycles for each motorcycle technician, and this indicates a need for more entry-level technicians.

   c. An increase in the ____________ ____________ population with ____________ personal incomes will continue to increase the demand for motorcycles, scooters, and three and four-wheel all terrain vehicles.

   d. Jet skis and similar gasoline-powered ____________ have also added to the demand for technicians.

   e. Gasoline-powered ____________ carts provide another service need and source of future technician employment.

   f. As dealerships expand to include lines of ____________ equipment such as generators, water pumps, lawn mowers, and snow blowers, the need for technicians to repair them will also increase.

   g. As motorcycle manufacturers move into production of ____________ engines, another service area will be created.

   h. An increase in motorcycle ownership among older age groups and ____________ ____________ will help increase the need for technicians.

   i. Past motorcycle designs afforded owners with opportunities for many do-it-yourself repairs, but the ____________ of modern motorcycle demands ____________ repair.

3. Select true statements concerning career opportunities by placing an "X" beside each statement that is true.

   _____a. An entry-level motorcycle technician will average more than 10 dollars per hour, and experienced technicians earn 20 to 25 dollars an hour.

   _____b. Some technicians are paid on a commission basis which usually gives them 40 percent of the labor charged the customer.

   _____c. The commission system inspires speed and quality workmanship and rewards the professional technician, especially during peak seasons.

   _____d. Experienced technicians with leadership capabilities often advance to management positions.

TEST

4. Complete statements concerning working conditions by circling the word(s) that best completes each statement.

   a. Motorcycle repair shops are (**seldom, usually**) well lighted, well ventilated, and climate-controlled for technician comfort.

   b. The days of the (**loud, big**) motorcycle have passed and repair shops are no longer the (**noisy, crowded**) places they used to be when engines were being tested.

   c. Employees in most motorcycle repair facilities develop close personal and professional ties and frequently join together to enjoy races, rallies, and other (**after work, daytime**) activities.

   d. The demand for motorcycle service is highest in the (**cold, warm**) weather months, and during peak periods technicians may work overtime frequently.

   e. Although motorcycling is seasonal in some northern areas, repairs of ATV's, (**winter recreational vehicles, ski trails**), and snow blowers alleviates off-season declines.

   f. Many dealerships offer fringe benefits ranging from life and health insurance to paid vacations, and dealer-sponsored trips to races, rallies, and (**service schools, foreign vacations**).

   g. As dealerships expand product lines, technicians have to continue improving skills because the next repair work may be a lawn mower, and a well rounded technician should be able to work on (**anything that comes in the door, at least two different types of equipment**).

5. List three prerequisites recommended for motorcycle technicians.

   a. ____

   b. ____

   c. ____

6. Match advancement opportunities with their job descriptions.

   ______a. Writes work orders, makes repair estimates, but most of all is the professional that alerts customers to repairs necessary for bike safety or performance

   ______b. Coordinates all service work, makes sure necessary parts are available for repair work, assists technicians with difficult jobs, schedules set-up of new units with sales needs, and orients new customers to bike safety and maintenance requirements

   ______c. Responsible for the overall operation of a dealership including ordering new bikes, keeping proper inventory, checking paperwork from shop to front office, and generally looking after the public relations and promotional activities of the business

   1. General manager
   2. Shop or dealership owner
   3. Service writer
   4. Factory rep
   5. Service manager
   6. Vocational instructor

TEST

_____d. Works as a representative of a motorcycle manufacturer to insure that dealerships are taking advantage of manufacturer's professional assistance with sales, service, and general operations

_____e. Manages, buys, sells, hires, fires, and generally does everything necessary to keep customers happy and maintain a healthy business

_____f. Teaches motorcycle service and repair to students interested in becoming professional motorcycle technicians

7. Complete statements concerning entry-level job assignments by inserting the word(s) that best completes each statement.

a. Entry-level technicians _____________ work in the sales or parts department.

b. Entry-level technicians almost always start work in the _____________ department.

c. Entry-level technicians usually work in the service department's two most important areas:

1) _____________ service

2) _____________ and pre-delivery service

d. Improper tire repair can result in customer _____________ and expensive liability suits against the company.

e. A bike improperly assembled or carelessly assembled will result in poor customer satisfaction, inspire bad word-of-mouth _____________, and could result in a _____________ suit against the company.

f. In short, although entry-level technicians repair tires and set up bikes, the two areas are critical to success of the dealership and are very important jobs where good workmanship will be _____________.

8. Complete statements concerning other entry-level service responsibilities by inserting the word(s) that best completes each statement

a. There are many specialized tools and major pieces of equipment in a service area, and beginning technicians must learn how to safely use and _____________ the equipment and tools they must have to do their jobs.

b. Proper use of tools must be learned to avoid personal injury, but proper tool and equipment use also helps avoid damage to _____________ units or to _____________ vehicles.

TEST

c. More than 95% of all motorcycles sold in America are manufactured with ____________ specifications, and technicians must know how to use ____________ in service and repair activities.

d. Motorcycles are held together with an assortment of nuts, screws, bolts, clips, pins, and other devices known as ____________, and a technician must develop skills in working with ____________.

e. As a member of the service department, a beginner will be called upon to handle paperwork properly, locate parts indexed on microfiche, talk with customers, and sometimes ____________ ____________ ____________ or work at the ____________ ____________.

f. Entry-level technicians need to know ____________ and ____________ engine theory so they can develop the skills required for properly diagnosing engine problems.

g. Battery and ____________ problems provide some of the biggest headaches in motorcycle repair, and the technician who develops skills in these areas will be of special value.

h. Beginning technicians also need service skills with brakes, clutches, suspensions, final drives, fuel systems, chassis service, wheel service and repair, and starting and ____________ systems.

i. Although tune-ups are usually performed by skilled technicians, beginners often get to work on ____________ motors and should make an extra effort to develop good tune-up skills.

j. Entry-level technicians must never forget that as they learn new skills they are still expected to do some of the basic things a business requires, and that may include cleaning the parking lot and ____________ ____________.

9. Solve the following problems concerning customer relations.

a. A customer starts talking to you about a problem and becomes very upset as he tries to explain what is wrong. Why is he angry and what would you do?

____

____

b. You are alone in the service department and have to answer the phone. What procedure would you use?

____

____

TEST

10. Complete statements concerning keys to advancement by inserting the word(s) that best completes each statement.

    a. A good ____________ ____________ and a professional attitude are the keys to advancement as a motorcycle repair technician.

    b. Technicians who are sloppy, dirty, and poorly groomed inspire ____________ responses, and customers ____________ ____________ continue doing business where such people work.

    c. Technicians who are clean and well groomed inspire ____________ responses, and customers ____________ continue doing business where these people work.

    d. A professional attitude inspires good work habits such as ____________ ____________ ____________ ____________ ____________ and putting in a full day's work for a full day's pay.

    e. Bikes were once sold to a predominantly young group, but the more mature group of people buying bikes today prefer technicians whose personal appearance reflects ____________.

    f. A professional attitude inspires good ____________ that customers appreciate and that the technician gets a personal reward from.

    g. Even with good mechanical skills, a technician with poor personal appearance and a don't-care attitude will ____________ ____________ ____________ in the motorcycle repair business.

    h. ____________ is primary to success in all walks of life, and trustworthy technicians do not help themselves to spare parts or supplies without paying for them.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Evaluate your potential as a motorcycle repair technician. (Assignment Sheet #1)

12. Visit a motorcycle dealership and make written reports about functions of various departments. (Assignment Sheet #2)

INTRODUCTION TO MOTORCYCLE REPAIR
UNIT I

ANSWERS TO TEST

1. a. 3
   b. 8
   c. 6
   d. 5
   e. 9
   f. 1
   g. 4
   h. 7
   i. 2
   j. 10

2. a. Grow
   b. 850
   c. Young adult, higher
   d. Watercraft
   e. Golf
   f. Power
   g. Outboard
   h. Senior citizens
   i. Complexity, professional

3. b, c, d

4. a. Usually
   b. Loud, noisy
   c. After work
   d. Warm
   e. Winter recreational vehicles
   f. Service schools
   g. Anything that comes in the door

5. Any three of the following:
   a. An interest in science and mathematics is beneficial to a potential motorcycle technician.
   b. Persons who have studied small engine repair or auto mechanics are well prepared to enter motorcycle repair programs.
   c. People who own their own motorcycles and have had practical experience in service and repair usually make good technicians.
   d. Employers prefer that entry-level technicians have a high school education.
   e. The ability to read and comprehend service manuals and other technical materials is vital to the success of a technician.

6. a. 3
   b. 5
   c. 1
   d. 4
   e. 2
   f. 6

ANSWERS TO TEST

7. a. Seldom
   b. Service
   c. 1) Tire
      2) Assembly
   d. Injury
   e. Advertising, liability
   f. Noticed

8. a. Maintain
   b. New, customer
   c. Metric, metrics
   d. Fasteners, fasteners
   e. Answer the phone, cash register
   f. 2-cycle, 4-cycle
   g. Electrical
   h. Charging
   i. Smaller
   j. Sweeping floors

9. a. Customers have difficulty talking about technical problems, plus they are upset about the problems to begin with, so be patient with the customer and try to tactfully calm the customer down.
   b. 1) Identify the company, give your name, and ask, "May I help you?"
      2) Take notes if you need to and be sure to have the customer repeat anything you don't understand.
      3) When looking something up requires a great deal of time, remind the customer every now and then that you're still taking care of the problem.
      4) Speak clearly and politely with a phone customer, and if you don't know the answer to a customer's question, give the call to someone who can help.
      5) Conclude phone conversations on a positive note by thanking the customer for calling your place of business.

10. a. Personal appearance
    b. Negative, will not
    c. Positive, will
    d. Getting to work on time
    e. Responsibility
    f. Workmanship
    g. Not last long
    h. Honesty

11. Evaluated to the satisfaction of the instructor

12. Evaluated to the satisfaction of the instructor

GENERAL SAFETY
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the benefits of working safely, major causes of accidents, safe tool and equipment use, and guidelines for safe lifting. The student should also be able to recognize typical hazards around a motorcycle service department and administer first aid for common workplace injuries. These competencies will be evidenced by correctly performing the procedures outlined in the assignment sheets and by scoring 100 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to general safety with their correct definitions.
2. Select true statements concerning benefits of safe working practices.
3. Complete statements concerning the major causes of accidents.
4. State the motto for good housekeeping.
5. Complete statements concerning basic rules for safe use of tools and equipment.
6. Solve a problem concerning safe lifting.
7. Complete statements concerning special requirements for test riding.
8. Select true statements concerning fire safety.
9. Complete statements concerning special hazards with welding equipment.
10. Match classes of fires with their causes.
11. Solve problems concerning fire extinguisher requirements.
12. Solve problems concerning battery safety.
13. Complete statements concerning fuel, solvent, and chemical hazards.

OBJECTIVE SHEET

14. Complete statements concerning special hazards with carburetor cleaner.
15. Select true statements concerning electrical safety.
16. Complete statements concerning ways to recognize shock.
17. Arrange in order the steps in treating shock.
18. Complete statements concerning first aid guidelines for common workplace injuries.
19. Complete statements concerning first aid guidelines for workplace burns.
20. Arrange in order the steps in controlling bleeding.
21. Identify pressure points for checking bleeding.
22. Complete statements concerning first aid for eye injuries.
23. Complete statements concerning general guidelines for first aid emergencies.
24. Select true statements concerning special rules for eye protection.
25. Complete statements concerning special rules for using compressed air.
26. Complete a student safety pledge. (Assignment Sheet #1)
27. Draw a floor plan and locate safety equipment in your shop. (Assignment Sheet #2)

GENERAL SAFETY
UNIT II

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information and assignment sheets.

C. Make transparencies.

D. Discuss information and assignment sheets.

E. Arrange for a talk about fire safety with your local fire department, and back it up with a fire drill, identification of reassembly points, and a demonstration of proper use of all fire extinguishers in the class/shop area.

F. Review procedures for a tornado alert.

G. Arrange for qualified medical personnel to talk about first aid and give demonstrations of dressing common cuts, punctures, and burns, and also demonstrations of resuscitation methods.

H. Stress the importance of eye safety, the importance of wearing eye protection when using striking tools, drill presses, and grinding tools, and demonstrate the use of available eye flushing equipment.

I. Review any special safety rules of the school, and impress upon the students the importance of signing the safety pledge in Assignment Sheet #1.

J. Invite the service manager of a local dealership to talk to the class about the potential hazards in a service area and ways to avoid them.

K. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. The American Red Cross. *Standard First Aid and Personal Safety.* Garden City, NJ: Doubleday and Co., Inc., 1978.

B. Henderson, John, M.D. *Emergency Medical Guide.* New York, NY: McGraw-Hill, 1963.

C. *Kansas Safety Education Handbook, Volume III.* Wichita, KS: Kansas State Department of Education in Cooperation with the Wichita Public Schools, U.S.D. 259, 1981.

D. *Kidde Portable Extinguishers, The ABC's of Fire Prevention.* Belleville, NJ: Walter Kidde & Co., Inc., 1978.

GENERAL SAFETY
UNIT II

INFORMATION SHEET

I. **Terms and definitions**

   A. Safety — State or condition of being safe; freedom from danger, risk, or injury

   B. Accident — Any suddenly occurring, unintentional event which causes personal injury or property damage

   C. First aid — Immediate, temporary care given the victim of an accident or sudden illness until the service of a physician can be obtained

   D. Pressure points — Points on the body where arteries pass close to the surface of the skin and in front of bone structure so that pressure forcing the artery against the bone can check the flow of blood to a specific part of the body

   E. Combustible — Materials or liquids that catch fire easily

   F. Hygiene — The science of good health and its maintenance, including sanitary practices and cleanliness

   G. Tetanus — An acute, infectious disease that usually enters the body through cuts or wounds; characterized by spasmodic contractions or rigidity of some voluntary muscles and frequently referred to as lockjaw

   H. Tourniquet — A bandage or strap twisted around a limb to compress the flow of blood through arteries and check severe bleeding; previously a recommended first aid procedure, but now recommended not at all or only in life-threatening situations

   I. Toxic substance — Poison or any substance that is poisonous

   J. Volatile substance — Any substance that evaporates quickly and has a potential to catch fire or explode

II. **Benefits of safe working practices**

   A. Eliminates the pain or discomfort of personal injury

   B. Eliminates the loss of equipment or the expense of repair

   C. Eliminates lost time and lost wages

   D. Contributes to the psychological well being of all employees

   E. Contributes to productivity and job security

   F. Fulfills the moral obligation a worker has to employer and fellow employees

INFORMATION SHEET

III. The major causes of accidents

A. Unsafe condition — May be caused by improper design, improper installation, or improper maintenance of a tool, machine, or any piece of equipment

Example: Unguarded machinery, mushroomed heads on striking tools, poor housekeeping, and poor lighting are all unsafe conditions

B. Unsafe act — The violation of a commonly accepted safe practice

Example: Removing machinery guards, throwing material instead of carrying it, improper lifting, and horseplay are all unsafe acts

C. Combination causes — An unsafe condition combined with an unsafe act causes the majority of accidents

Example: Firmly grasping a wrench being pushed toward an open metal edge can severely injure knuckles and fingers if the wrench slips or the nut loosens sooner than expected

D. Test riding — Most often caused when a technician testing a bike is paying more attention to the bike than to traffic hazards

Example: The technician may be looking down or attempting to adjust something on the bike while it is still moving in traffic

IV. Guidelines for good housekeeping

A. Keep tools and materials out of passageways.

B. Stack materials neatly away from passageways, walkways, electrical outlets, and work areas.

C. Immediately wipe up any oil or water that you or anyone else may have spilled on the floor.

D. Store all rags in a fire-proof metal container with a tight lid.

E. Dispose of oily rags that will not be used again, and be sure to place them in a proper receptacle.

F. Practice good housekeeping at all times because it is one of the most important parts of accident prevention.

G. Inspect electrical cords and plugs before using them, and do not carelessly pull or drag an electrical cord when using it.

H. Return tools and unused materials to proper storage when you're through with a job, and make sure the tools are clean and dry.

I. Remember the motto for good housekeeping: a place for everything and everything in its place.

INFORMATION SHEET

V. **Basic rules for safe use of tools and equipment**

A. When using a screwdriver, support the work on a bench or against a solid surface.

B. When using a wrench, pull it toward the body to prevent smashing your hand if the wrench should slip.

C. Do not strike a mushroomed punch or chisel; pieces of it may strike you in the eye or the hammer may slip and injure your hand.

D. Wear safety goggles when using striking tools.

E. Be especially careful of burrs and fish hooks which are left on the edge of sheet metal; they can cause severe cuts.

F. Never use a file without a handle; the tang could easily pierce your hand and cause a serious injury.

G.. When working with a drill press, remove the chuck and clamp the work in place.

H. When grinding or polishing, always wear a face shield.

I. Never operate a machine from which the guards have been removed.

J. Do not let molten solder come in contact with wet metal because the solder will blow up in your face and eyes.

(NOTE: Only fools solder without wearing safety glasses.)

K. Do not let soldering acid flux get on your skin or in your eyes because it can cause serious injury.

VI. **Safe lifting**

A. Back problems related to unsafe lifting are the number one items in worker's compensation claims.

B. Most unsafe lifting injuries happen because someone underestimates the weight of a load.

C. Many other unsafe lifting injuries happen because a load shifts.

Example: As a motorcycle is being lifted out of its crate, it poses a cumbersome load that is difficult to handle because it may go one way or the other, and that is why you should always have help when unloading a bike and should use a ramp or an unloading dock

D. Safe lifting demands sizing up the load, bending at the knees, and lifting straight up while using leg power instead of lifting with the back.

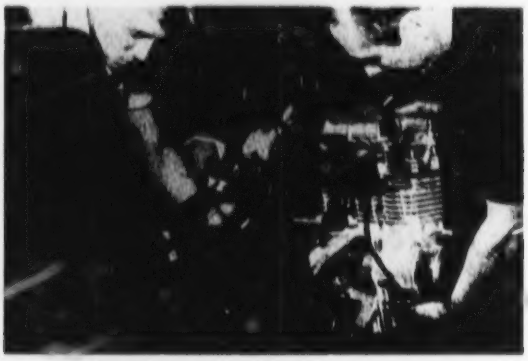
INFORMATION SHEET

E. Safe lifting also demands a safe pathway to follow as you move a load, so this requires checking out a safe route prior to picking up the load.

F. Lifting heavy engines from motorcycles requires supporting the upper torso on the frame of the bike and lifting with your arms. (Figure 1)

(NOTE: When properly executed, lifting with the arms can be safe, and with heavy engines, supporting the upper torso is essential, but no one should attempt to lift an extra-heavy engine without help.)

FIGURE 1



VII. **Special requirements for test riding**

A. Most serious injuries around dealerships happen during test rides.

B. Never test ride without a safety helmet and adequate protective clothing.

C. If the test ride will require hard acceleration or high speeds, pick a remote test route with minimum traffic.

D. Beware of traffic hazards at all times and don't concentrate on the bike to the point that you forget where you are.

E. Test rides must be realistic, but safety should be the number one concern, and respect for the customer's property is essential.

VIII. **Fire safety**

A. Statistics indicate that close to 75 percent of dealership fires start in the service department.

B. The three major causes of service department fires are:

1. Improper storage of gasoline and other combustible cleaning agents
2. Improper refueling procedures that permit gasoline to spill on a bike or into the shop area

INFORMATION SHEET

3. Fuel leaking from a stored bike because it's tilted at an angle that permits gasoline to drip from the carburetor

C. Store gasoline cans outside the service area.

D. Take bikes outside to refuel them, or if refueling is done inside, make sure the area is well ventilated and have someone standing by with a fire extinguisher.

E. Check stored bikes for gas or oil leaks, and clean up spills immediately.

F. If a stored bike is leaking fuel or oil, drain the gas tank and the crank case.

G. If a bike catches fire and you can't put the fire out immediately, get safely away because chances are it will explode.

IX. **Special hazards with welding equipment**

A. NEVER weld on a fuel tank without proper preparation.

B. NEVER weld on the frame or any part of a machine that has the fuel tank still installed.

C. Remove the fuel tank and drain or remove the complete fuel system before welding anywhere on a unit.

D. ALWAYS have a fire extinguisher nearby when welding.

E. NEVER use welding equipment without the proper safety helmet and lens, and never use cutting equipment without wearing cutting goggles.

F. ALWAYS wear protective gloves and protective apron or clothing when welding or cutting.

G. NEVER operate oxyacetylene cutting equipment near combustibles.

H. NEVER use oil near oxyacetylene equipment because the interaction of oil and oxygen will cause a violent explosion.

I. Before arc welding on a bike, disconnect the battery, and do not arc weld near a battery.

X. **Classes of fires and their causes** (Transparency 1)

A. Class A fires — Result from ordinary combustibles such as wood, paper, and cloth

B. Class B fires — Result from flammable liquids such as gasoline, oil, paint, solvents, and grease

C. Class C fires — Result from electrical wires, switches, and motors

INFORMATION SHEET

XI. **Fire extinguisher requirements** (Transparency 1)

A. Fire extinguishers should be located at unobstructed, clearly visible locations around the dealership.

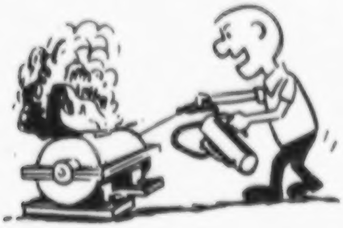
B. Fire extinguishers should have inspection tags to indicate they have been regularly checked and are in good working order.

C. The fire extinguisher recommended for motorcycle service areas is the multi-purpose dry chemical fire extinguisher.

(NOTE: A multi-purpose extinguisher should have the letters A, B, C prominently displayed on the canister.)

D. To use a multi-purpose extinguisher properly, direct the chemical at the base of the flame. (Figure 2)

FIGURE 2



E. Never try to extinguish a gasoline or oil fire by throwing water on it because chances are it will spread the fire.

XII. **Battery safety**

A. Battery service requires special care because a fully-charged or a battery being charged emits highly explosive hydrogen gas.

B. The prime rules for working with batteries are:

1. Remove the negative cable first.
2. Install the positive cable first.

(NOTE: With the negative or ground cable removed, there is no chance that an electrical circuit could be completed to cause a spark.)

INFORMATION SHEET

C. Always wear a face shield when performing any kind of battery service.

(NOTE: Acid is only part of the danger if a battery explodes; the greater danger is created by shrapnel-like pieces of plastic from the battery case.)

D. Use a battery charger of proper amperage when recharging a battery.

E. Dispose of old batteries in accordance with legal requirements.

XIII. Fuel, solvent, and chemical hazards

A. Gasoline is the number one hazard in a bike shop, and it is especially a danger because of the high heat generated by an air-cooled engine and the close location of a hot exhaust pipe.

B. If gasoline leaks from a fuel tank, it runs down directly over the engine and onto the exhaust pipe and creates an immediate fire and explosion hazard.

C. Allow an exhaust ample time to cool off before draining oil from a bike or changing the oil filter because any oil that leaks will contact the exhaust.

D. Penetrating oils and other pressurized lubricants and cleaners are highly volatile and must not be used near heat or an open flame.

E. Always make sure there is no one in the line of spray when using pressurized lubricants and cleaners because some of these products have toxic ingredients.

F. Always wear rubber gloves when working with cleaning solvents because they contain harsh drying and detergent agents that can severely irritate the skin.

G. If you get solvent on any part of your body or on your clothes, immediately wash the affected area with soap and water, and change clothes.

H. Battery acid is always a potential danger because it is often spilled; when this happens, always wash the affected area with soap and water, change clothes, and wash the clothes that acid was spilled on.

I. Baking soda is an excellent neutralizing agent for battery acid, and a box of common household baking soda should be kept around battery service areas.

J. Keep motor oil off your hands and skin because it contains harmful hydrocarbons and detergents.

K. Dispose of old motor oil in accordance with legal requirements.

INFORMATION SHEET

XIV. **Special hazards with carburetor cleaner**

A. Carburetor cleaner is actually a toxic acid that demands special care.

B. Since cleaning a carburetor requires placing the parts in a basket that is lowered into the cleaner container, there is a danger of splashing cleaner on hands and clothes.

C. Removing the basket poses another danger because solvent can drip or run onto your shoes and feet.

D. Carburetor parts that have been cleaned must be rinsed with water, and sometimes flowing water will cause solvent residue to splash on your skin.

E. Drying clean parts with compressed air poses another danger because solvent residue can easily be blown back into your face or onto your skin.

F. Wearing a face shield when working with carburetor cleaner is a must.

G. Wearing rubber gloves when working with carburetor cleaner is also recommended.

(NOTE: Some shops require wearing a rubber apron when working with carburetor cleaner or battery acid.)

H. Do not wash carburetor parts in a solvent tank, for it will contaminate the solvent.

I. In all cases, a carburetor cleaner spill or splash should be cleaned with generous amounts of water, and any skin areas exposed to cleaner should be washed with soap and water.

XV. **Electrical safety**

A. Do not use power cords that are cracked or frayed.

B. Unplug the power cord before repairing any piece of power equipment.

C. Avoid placing power cords or extension cords across walkways or around moving equipment.

D. Never saw off the grounding prong on a three-prong extension cord because that defeats the circuit ground and can be dangerous.

E. Wipe power cords and extension cords free of antifreeze, grease, or moisture before storing them.

F. Repair or replace frayed plug-ins.

INFORMATION SHEET

XVI. **Ways to recognize shock**

A. Skin is pale or bluish.

B. Skin may be moist and clammy, even cold to the touch.

C. Victim feels weak.

D. Pulse is rapid and weak.

E. Breathing rate is fast and irregular.

F. Victim may be confused or incoherent.

XVII. **Steps in treating shock**

A. Notify supervisor or instructor IMMEDIATELY.

B. DO NOT DELAY immediate first aid treatment; it can be life saving.

C. Eliminate the causes of shock, control bleeding, or administer artificial respiration if the victim is not breathing.

D. Keep victim lying down with feet slightly elevated.

(CAUTION: If the victim has sustained a head or chest injury, do not elevate the feet. Leave the victim lying flat, and when in doubt about the nature of the wound, leave the victim lying flat.)

E. Cover the victim to retain body heat, but do not make the victim sweat.

F. Give no liquids or food to a shock victim.

XVIII. **First aid guidelines for common workplace injuries**

A. Report all cuts, punctures, splinter wounds, and abrasions to your supervisor or instructor.

B. Minor cuts should be cleaned with soap and water, rinsed, and covered with a dry, sterile dressing.

C. Puncture wounds should be cleaned with soap and water, rinsed, then cleaned and rinsed again before covering with a dry, sterile dressing.

D. Slivers and splinters that do not penetrate deeply should be treated as puncture wounds, but splinters that penetrate deeply should be removed by a doctor.

E. Regardless of severity, all cuts, punctures, and splinter injuries should be treated immediately to avoid infection.

F. Depending on the cause of the cut, puncture, or splinter wound, it is usually wise to consider tetanus a hazard.

INFORMATION SHEET

XIX. **First aid guidelines for workplace burns**

A. Notify your supervisor or instructor.

B. Always treat the victim for shock.

C. In the case of a chemical burn, wash off the chemical with large quantities of running water, and cut clothing off the affected area.

D. In the case of thermal burns, cut away clothing from the area of the burn, but do not try to remove material that adheres to the burn.

E. With all burns, apply a thick, sterile dressing to prohibit air from reaching the burn.

XX. **Steps in controlling bleeding**

A. Place a compress of sterile gauze or the cleanest available material directly over the bleeding site.

B. Press firmly with fingers or palm of hand.

C. Elevate the bleeding parts above the heart level unless there is evidence of a fracture.

D. If blood soaks through the first compress, place another compress on it, but do not remove the first compress.

E. Secure compress with a pressure bandage.

F. Treat for shock.

G. If there is a severe life-threatening hemorrhage, AND ONLY AS A LAST RESORT, APPLY A TOURNIQUET.

(CAUTION: There is an enormous pressure build-up at the point of tourniquet application. Premature loosening of the tourniquet could cause an excessive loss of blood, and that is why a tourniquet, once applied, should not be loosened except by a physician or on the advice of a physician.)

XXI. **Pressure points for checking bleeding** (Transparency 2)

A. Bleeding from the front of the face can often be controlled by pressing the facial artery.

B. Bleeding from the armpit, or sometimes the entire arm, can often be controlled by pressure on the subclavian artery.

C. Bleeding from an arm can often be controlled by pressure on the brachial artery.

INFORMATION SHEET

D. Bleeding from a leg can often be controlled by deep pressure on the femoral artery.

(CAUTION: The pressure point must be between the heart and the wound. Instruction by a qualified first aid instructor is the best way to learn where the pressure points are and how to be sure the right one is selected.)

XXII. First aid for eye injuries

A. Notify your supervisor or instructor immediately.

B. Every eye injury should receive immediate first aid attention.

C. For an apparent minor object in the eye, have the person wink several times. If the tears produced by winking do not remove the object, assume that the object is embedded and use the following procedure:

1. Have the victim close his or her eyes.
2. Put a piece of moist cotton over the closed lid.
3. Place a bandage over the cotton.
4. Get the victim to a doctor as soon as possible.

D. When the eyeball has been obviously scratched or penetrated, apply a sterile dressing, bandage *loosely,* and get medical help immediately.

E. Never permit the victim of an eye injury to rub his or her eye.

F. When in doubt about any eye injury, seek the most immediate medical attention whether it's on the job or in the classroom.

G. Even though damage may be confined to one eye, it is sometimes best to bandage both eyes with a sterile dressing so the victim will not have a tendency to move the damaged eye.

H. For chemical or acid splashes, flush the eyes repeatedly at an eye-flushing station or use a bottled, portable flushing solution, then seek immediate medical assistance.

XXIII. General guidelines for first aid emergencies

A. Report all accidents and injuries to your instructor or jobsite supervisor, no matter how minor they may seem to be.

B. Never hesitate to administer first aid when it is needed.

(CAUTION: Resuscitation procedures require special training and should not be practiced by untrained persons.)

C. Always have a reason for what you do.

INFORMATION SHEET

D. Reassure the injured person that everything possible is being done.

(NOTE: Hearing the concerned voice of a co-worker is psychologically comforting to an injured person and can actually lessen the degree of shock.)

E. Make accurate notes about the accident including name of victim, time, place, cause or nature of the accident, and any first aid that was administered.

F. Do not notify the victim's family because this is the responsibility of the school, the jobsite supervisor, or the medical facility.

G. File a complete accident report and submit a copy to the proper persons. (Transparency 3)

(NOTE: Follow emergency procedures that have been adopted by the local school board or the directing agency.)

XXIV. **Special rules for eye protection**

A. Wear safety glasses at all times in the shop.

B. Wear safety goggles with correct shaded lenses when working with oxyacetylene cutting equipment.

C. Wear a welding helmet with proper lens shade when arc welding.

(CAUTION: Arc welding areas should be shielded to avoid eye injuries to anyone nearby.)

D. Wear safety goggles when soldering.

E. Wear a face shield when grinding, and remember that sparks from grinding are dangerous.

F. Any form of eye protection should be kept clean so it will not impair the view of materials or the work area.

XXV. **Special rules for using compressed air**

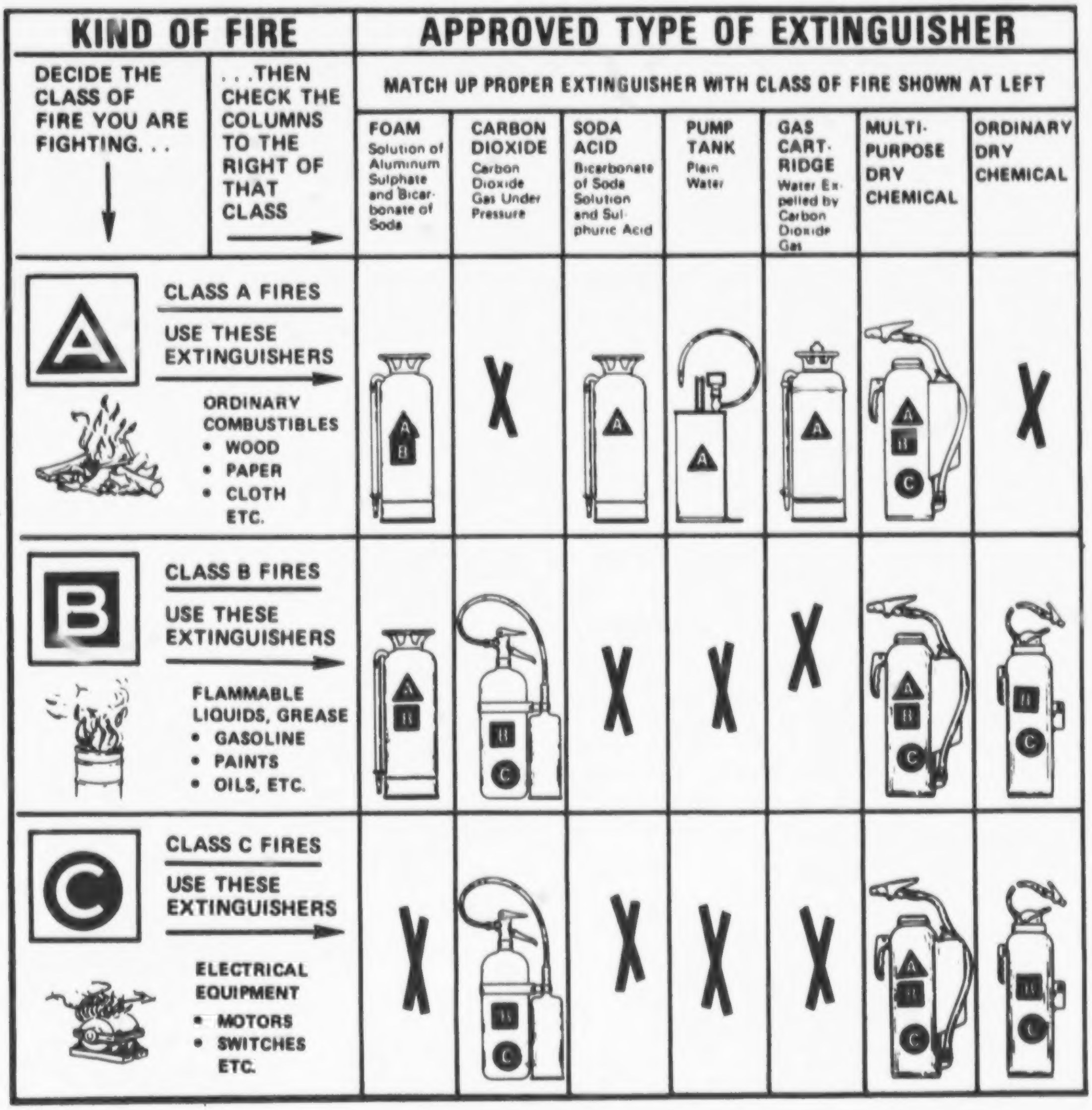
A. Wear safety glasses when using compressed air.

B. Point the air nozzle away from you when using compressed air.

C. Make sure fellow workers are clear of the area where the compressed air will blow dirt or debris.

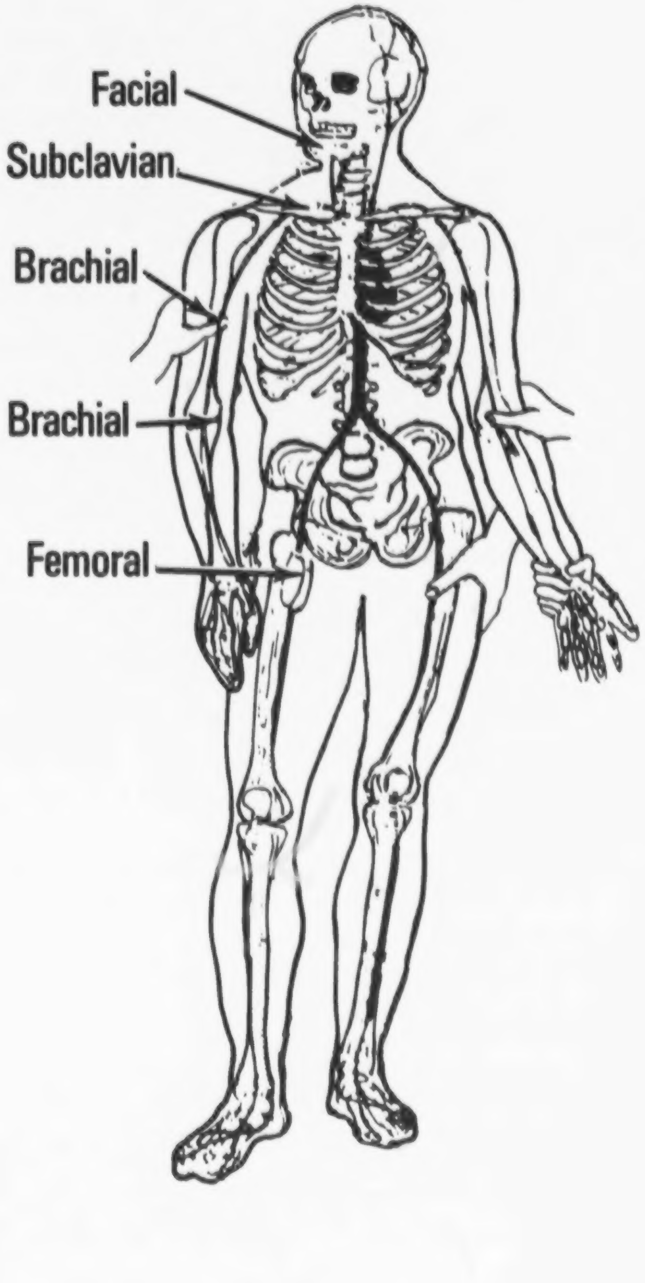
D. Beware of hard surfaces that the compressed air could strike and cause debris to ricochet back into your face.

Fire Safety

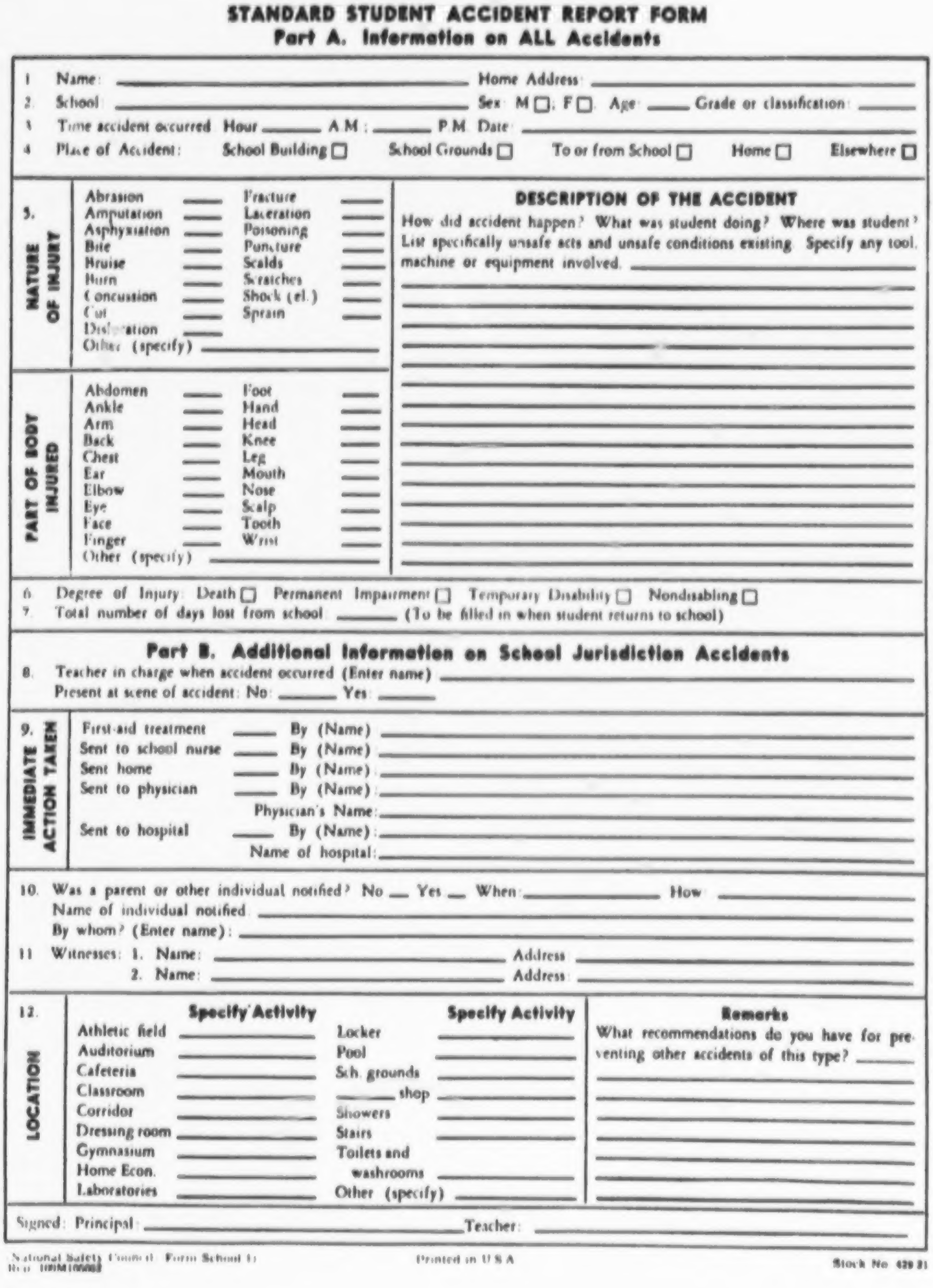


KIND OF FIRE		APPROVED TYPE OF EXTINGUISHER						
DECIDE THE CLASS OF FIRE YOU ARE FIGHTING. . . ↓	. . .THEN CHECK THE COLUMNS TO THE RIGHT OF THAT CLASS →	MATCH UP PROPER EXTINGUISHER WITH CLASS OF FIRE SHOWN AT LEFT						
		FOAM Solution of Aluminum Sulphate and Bicarbonate of Soda	CARBON DIOXIDE Carbon Dioxide Gas Under Pressure	SODA ACID Bicarbonate of Soda Solution and Sulphuric Acid	PUMP TANK Plain Water	GAS CARTRIDGE Water Expelled by Carbon Dioxide Gas	MULTI-PURPOSE DRY CHEMICAL	ORDINARY DRY CHEMICAL
A	CLASS A FIRES USE THESE EXTINGUISHERS → ORDINARY COMBUSTIBLES • WOOD • PAPER • CLOTH ETC.	A B	X	A	A	A	A B C	X
B	CLASS B FIRES USE THESE EXTINGUISHERS → FLAMMABLE LIQUIDS, GREASE • GASOLINE • PAINTS • OILS, ETC.	A B	B C	X	X	X	A B C	B C
C	CLASS C FIRES USE THESE EXTINGUISHERS → ELECTRICAL EQUIPMENT • MOTORS • SWITCHES ETC.	X	B C	X	X	X	A B C	B C

Pressure Points


Facial
Subclavian
Brachial
Brachial
Femoral

Accident Report Form



STANDARD STUDENT ACCIDENT REPORT FORM

Part A. Information on ALL Accidents

1. Name: ____ Home Address: ____
2. School: ____ Sex: M ☐; F ☐ Age: ____ Grade or classification: ____
3. Time accident occurred: Hour ____ A.M.; ____ P.M. Date: ____
4. Place of Accident: School Building ☐ School Grounds ☐ To or from School ☐ Home ☐ Elsewhere ☐

5. NATURE OF INJURY

Abrasion ____
Amputation ____
Asphyxiation ____
Bite ____
Bruise ____
Burn ____
Concussion ____
Cut ____
Dislocation ____
Other (specify) ____

Fracture ____
Laceration ____
Poisoning ____
Puncture ____
Scalds ____
Scratches ____
Shock (el.) ____
Sprain ____

PART OF BODY INJURED

Abdomen ____
Ankle ____
Arm ____
Back ____
Chest ____
Ear ____
Elbow ____
Eye ____
Face ____
Finger ____
Other (specify) ____

Foot ____
Hand ____
Head ____
Knee ____
Leg ____
Mouth ____
Nose ____
Scalp ____
Tooth ____
Wrist ____

DESCRIPTION OF THE ACCIDENT

How did accident happen? What was student doing? Where was student? List specifically unsafe acts and unsafe conditions existing. Specify any tool, machine or equipment involved. ____

6. Degree of Injury: Death ☐ Permanent Impairment ☐ Temporary Disability ☐ Nondisabling ☐
7. Total number of days lost from school ____ (To be filled in when student returns to school)

Part B. Additional Information on School Jurisdiction Accidents

8. Teacher in charge when accident occurred (Enter name) ____
Present at scene of accident: No: ____ Yes: ____

9. IMMEDIATE ACTION TAKEN

First-aid treatment ____ By (Name): ____
Sent to school nurse ____ By (Name): ____
Sent home ____ By (Name): ____
Sent to physician ____ By (Name): ____
Physician's Name: ____
Sent to hospital ____ By (Name): ____
Name of hospital: ____

10. Was a parent or other individual notified? No ____ Yes ____ When: ____ How: ____
Name of individual notified: ____
By whom? (Enter name): ____
11. Witnesses: 1. Name: ____ Address: ____
2. Name: ____ Address: ____

12. LOCATION

Specify Activity		Specify Activity	
Athletic field	____	Locker	____
Auditorium	____	Pool	____
Cafeteria	____	Sch. grounds	____
Classroom	____	____ shop	____
Corridor	____	Showers	____
Dressing room	____	Stairs	____
Gymnasium	____	Toilets and washrooms	____
Home Econ.	____	Other (specify)	____
Laboratories	____		

Remarks

What recommendations do you have for preventing other accidents of this type? ____

Signed: Principal: ____ Teacher: ____

National Safety Council Form School 1; Rev. [illegible]
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Stock No. 429.21

GENERAL SAFETY
UNIT II

ASSIGNMENT SHEET #1 — COMPLETE A STUDENT SAFETY PLEDGE

________________________________ is enrolled in the motorcycle repair program at ____________________. Part of the training requires the student to operate tools and equipment. Such activities require written permission of parent(s) or guardian.

The student will be given proper instruction in the safe use of tools and equipment before being allowed to operate the equipment alone. The student will also be instructed in safety requirements. To assure that the student conducts herself/himself in a safe manner, the student is required to sign the following student safety pledge:

1. I promise to abide by all safety rules for the motorcycle repair program, and specifically to:
    a. Wear eye protection at all times in the shop
    b. To use power equipment only after proper instruction and only with the instructor's permission
    c. To take care of all tools and return them clean to proper storage
    d. To make sure the shop is properly ventilated before starting a motor
    e. To abide by all fire regulations, to respect no smoking rules, and to help with housekeeping as required
    f. To avoid horseplay at all times and obey safety rules and regulations of the school
2. I will report all accidents to the instructor immediately.

Date ____________ Student's Signature ______________________________

As parent(s) or guardian of ______________________________, consent is hereby granted for him/her to operate equipment as required for motorcycle repair classes.

Date ____________ Signature(s) ______________________________

Permission is is not (circle one) granted for the student to ride a motorcycle as needed for testing purposes.

Date ____________ Signature(s) ______________________________

GENERAL SAFETY
UNIT II

ASSIGNMENT SHEET #2 — DRAW A FLOOR PLAN AND LOCATE SAFETY EQUIPMENT IN YOUR SHOP

Directions: On a separate piece of paper, sketch a floor plan of your shop; make it large enough to provide the space to indicate the location of all of the following:

1. Indicate the location of all emergency exits and label those locations EE
2. Indicate where all fire extinguishers are located and label those locations FE
3. Indicate where the eye wash station is located and label that location EW
4. Indicate where the nearest telephone is located and label the location T, and beside it write the emergency telephone number
5. Indicate where the first aid kit is located and label the location First Aid
6. Indicate the reassembly point following a fire drill and show its approximate location with respect to the shop by labeling the location RP
7. Indicate the safe shelter for severe weather and show its approximate location with respect to the shop by labeling the location Safe Shelter
8. Indicate the location of the solvent disposal area and label the location Solvents
9. Indicate the location of the combustible storage area and label the area with a CS

ASSIGNMENT SHEET #2

GENERAL SAFETY
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 — Evaluated to the instructor's satisfaction

Assignment Sheet #2 — Evaluation should include not only the student's location of requested items, but attention to every question and how the labels are indicated should be checked carefully to test the student's ability to follow instructions. Another part of the evaluation should include neatness.

GENERAL SAFETY
UNIT II

NAME __________ __________

TEST

1. Match the terms on the right with their correct definitions.

_____a. State or condition of being safe; freedom from danger, risk, or injury

_____b. Any suddenly occurring, unintentional event which causes personal injury or property damage

_____c. Immediate, temporary care given the victim of an accident or sudden illness until the service of a physician can be obtained

_____d. Points on the body where arteries pass close to the surface of the skin and in front of bone structure so that pressure forcing the artery against the bone can check the flow of blood to a specific part of the body

_____e. Materials or liquids that catch fire easily

_____f. The science of good health and its maintenance, including sanitary practices and cleanliness

_____g. An acute, infectious disease that usually enters the body through cuts or wounds; characterized by spasmodic contractions or rigidity of some voluntary muscles and frequently referred to as lockjaw

_____h. A bandage or strap twisted around a limb to compress the flow of blood through arteries and check severe bleeding; previously a recommended first aid procedure, but now recommended not at all or only in life-threatening situations

_____i. Poison or any substance that is poisonous

_____j. Any substance that evaporates quickly and has a potential to catch fire or explode

1. Tetanus
2. Volatile substance
3. Combustible
4. Safety
5. Tourniquet
6. First aid
7. Hygiene
8. Toxic substance
9. Accident
10. Pressure points

TEST

2. Select true statements concerning benefits of safe working practices by placing an "X" beside each statement that is true.

_____a. Eliminates the pain or discomfort of personal injury

_____b. Eliminates the loss of equipment or the expense of repair

_____c. Eliminates lost time and lost wages

_____d. Contributes to the psychological well being of all employees

_____e. Contributes to productivity and job security

_____f. Fulfills the moral obligation a worker has to employer and fellow employees

3. Complete statements concerning the major causes of accidents by inserting the word(s) that best completes each statement.

a. Unsafe condition — May be caused by improper design, improper installation, or improper ____________ of a tool, machine, or any piece of equipment

b. Unsafe act — The violation of a commonly accepted ____________ practice

c. Combination causes — An unsafe ____________ combined with an unsafe ____________ causes the majority of accidents

d. Test riding — Most often caused when a technician testing a bike is paying more attention to the bike than to ____________ ____________

4. State the motto for good housekeeping.

____

____

5. Complete statements concerning basic rules for safe use of tools and equipment by inserting the word(s) that best completes each statement.

a. When using a screwdriver, support the work on a ____________ or against a ____________ surface.

b. When using a wrench, pull it ____________ the body to prevent smashing your hand if the wrench should slip.

c. Do not strike a ____________ punch or chisel; pieces of it may strike you in the eye, or the hammer may slip and injure your hand.

d. Wear safety ____________ when using striking tools.

TEST

e. Be especially careful of burrs and fish hooks which are left on the edge of ____________ ____________; they can cause severe cuts.

f. Never use a ____________ without a handle; the tang could easily pierce your hand and cause a serious injury.

g. When working with a ____________ ____________, remove the chuck and clamp the work in place.

h. When grinding or polishing, always wear a ____________ ____________.

i. Never operate a machine from which the ____________ have been removed.

j. Do not let ____________ ____________ come in contact with wet metal because the ____________ will blow up in your face and eyes.

k. Do not let soldering ____________ ____________ get on your skin or in your eyes because it can cause serious injury.

6. Solve the following problem concerning safe lifting.

Problem: Safe lifting requires using leg power instead of lifting with the back, but what lifting rules apply when lifting heavy engines from motorcycles?

Solution: ____

____

7. Complete statements concerning special requirements for test riding by inserting the word(s) that best completes each statement.

a. Most serious injuries around dealerships happen during ____________ ____________.

b. Never test ride without a ____________ ____________ and adequate ____________ clothing.

c. If the test ride will require hard acceleration or high speeds, pick a ____________ test route with ____________ traffic.

d. Beware of traffic hazards at all times and don't concentrate on the ____________ to the point that you forget where you are.

e. Test rides must be realistic, but ____________ should be the number one concern, and ____________ for the customer's property is essential.

TEST

8. Select true statements concerning fire safety by placing an "X" beside each statement that is true.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Statistics indicate that close to 75 percent of dealership fires start in the parts department.

_____b. The three major causes of service department fire are:

1) Improper storage of gasoline and other combustible cleaning agents

2) Improper refueling procedures that permit gasoline to spill on a bike or into the shop area

3) Fuel leaking from a stored bike because it's tilted at an angle that permits gasoline to drip from the carburetor

_____c. Store gasoline cans only in the service area.

_____d. Take bikes outside to refuel them, or if refueling is done inside, make sure the area is well ventilated and have someone standing by with a fire extinguisher.

_____e. Check stored bikes for gas or oil leaks, and clean up spills immediately.

_____f. If a stored bike is leaking fuel or oil, take it outside.

_____g. If a bike catches fire and you can't put the fire out immediately, get safely away because chances are it will explode.

9. Complete statements concerning special hazards with welding equipment by inserting the word(s) that best completes each statement.

a. NEVER weld on a fuel tank without ____________ preparation.

b. NEVER weld on the frame or any part of a machine that has the ____________ ____________ still installed.

c. Remove the fuel tank and drain or remove the complete ____________ ____________ before welding anywhere on a unit.

d. ALWAYS have a ____________ ____________ nearby when welding.

e. NEVER use welding equipment without the proper safety ____________ and ____________, and never use cutting equipment without wearing cutting ____________.

f. ALWAYS wear protective ____________ and protective ____________ or clothing when welding or cutting.

TEST

g. NEVER operate oxyacetylene cutting equipment near ____________.

h. NEVER use ____________ near oxyacetylene equipment because the interaction of ____________ and oxygen will cause a violent explosion.

i. Before arc welding on a bike, disconnect the ____________, and do not arc weld near a ____________.

10. Match classes of fires with their causes.

_____a. Result from ordinary combustibles such as wood, paper, and cloth

_____b. Result from flammable liquids such as gasoline, oil, paint, solvents, and grease

_____c. Result from electrical wires, switches, and motors

1. Class B fires
2. Class C fires
3. Class A fires

11. Solve problems concerning fire extinguisher requirements.

a. A fellow worker starts to throw a bucket of water on a fire. Is a safety rule about to be violated, and if so, what can be done to correct the situation?

____

____

b. You are asked to check the fire extinguishers around the shop to make sure they are in good operational order. What would you look for?

____

____

c. On what part of a fire should the chemical spray from a multi-purpose fire extinguisher be directed?

____

12. Solve the following problems concerning battery safety.

a. A fellow worker starts to service a battery while wearing no eye protection. Is there a problem, and if so, what is the solution?

____

____

TEST

b. A fellow worker knows that cables have to be disconnected from the battery before it can be safely serviced, and starts to remove the positive cable. Is there a problem, and if so, what is the solution?

____

____

13. Complete statements concerning fuel, solvent, and chemical hazards by inserting the word(s) that best completes each statement.

   a. ____________ is the number one hazard in a bike shop, and it is especially a danger because of the high heat generated by an air-cooled engine and the close location of a hot exhaust pipe.

   b. If gasoline leaks from a fuel tank, it runs down directly over the engine and onto the exhaust pipe and creates an immediate fire and ____________ hazard.

   c. Allow an exhaust ample time to ____________ ____________ before draining oil from a bike or changing the oil filter because any oil that leaks will contact the the exhaust.

   d. Penetrating oils and other pressurized lubricants and cleaners are highly volatile and must not be used near ____________ or ____________ flame.

   e. Always make sure there is no one in the line of spray when using pressurized lubricants and cleaners because some of these products have ____________ ingredients.

   f. Always wear ____________ ____________ when working with cleaning solvents because they contain harsh drying and detergent agents that can severely irritate the skin.

   g. If you get solvent on any part of your body or on your clothes, immediately wash the affected area with soap and water, and ____________ ____________.

   h. ____________ ____________ is always a potential danger because it is often spilled; when this happens, always wash the affected area with soap and water, change clothes, and wash the clothes that ____________ was spilled on.

   i. ____________ ____________ is an excellent neutralizing agent for battery acid, and a box of common household ____________ ____________ should be kept around battery service areas.

   j. Keep ____________ ____________ off your hands and skin because it contains harmful hydrocarbons and detergents.

   k. Dispose of old ____________ ____________ in accordance with legal requirements.

TEST

14. Complete statements concerning special hazards with carburetor cleaner by inserting the word(s) that best completes each statement.

    a. Carburetor cleaner is actually a ____________ acid that demands special care.

    b. Since cleaning a carburetor requires placing the parts in a basket that is lowered into the cleaner container, there is a danger of ____________ cleaner on hands and clothes.

    c. Removing the basket poses another danger because solvent can ____________ or ____________ onto your hands and feet.

    d. Carburetor parts that have been cleaned must be rinsed with water, and sometimes flowing water will cause solvent ____________ to splash on your skin.

    e. Drying clean parts with ____________ ____________ poses another danger because solvent residue can easily be blown back into your face or onto your skin.

    f. Wearing a ____________ ____________ when working with carburetor cleaner is a must.

    g. Wearing a ____________ ____________ when working with carburetor cleaner is also recommended.

    h. Do not wash carburetor parts in a solvent tank, for it will ____________ the solvent.

    i. In all cases, a carburetor cleaner spill or splash should be cleaned with generous amounts of water, and any skin areas exposed to cleaner should be washed with ____________ and ____________.

15. Select true statements concerning electrical safety by placing an "X" beside each statement that is true.

    _____a. Use power cords that are cracked or frayed very carefully.

    _____b. Unplug the power cord before repairing any piece of power equipment.

    _____c. Avoid placing power cords or extension cords across walkways or around moving equipment.

    _____d. Saw off the grounding prong on a three-prong extension cord only when you have to.

    _____e. Wipe power cords and extension cords free of antifreeze, grease, or moisture before storing them.

    _____f. Repair or replace frayed plug-ins.

TEST

16. Complete statements concerning ways to recognize shock by inserting the word(s) that best completes each statement.

    a. Skin is ____________ or bluish.

    b. Skin may be moist and clammy, even ____________ to the touch.

    c. Victim feels ____________.

    d. Pulse is ____________ and weak.

    e. Breathing rate is ____________ and irregular.

    f. Victim may be ____________ or incoherent.

17. Arrange in order the steps in treating shock by inserting the correct sequence number in the appropriate blank.

    _____a. Cover the victim to retain body heat, but do not make the victim sweat.

    _____b. Give no liquids or food to a shock victim.

    _____c. Eliminate the causes of shock, control bleeding, or administer artificial respiration if the victim is not breathing.

    _____d. Keep victim lying down with feet slightly elevated.

    _____e. Notify supervisor or instructor IMMEDIATELY.

    _____f. DO NOT DELAY immediate first aid treatment; it can be lifesaving.

18. Complete statements concerning first aid guidelines for common workplace injuries by inserting the word(s) that best completes each statement.

    a. Report all cuts, punctures, splinter wounds, and abrasions to your ____________ or ____________.

    b. Minor cuts should be cleaned with ____________ and ____________, rinsed, and covered with a dry, ____________ dressing.

    c. Puncture wounds should be cleaned with soap and water, rinsed, then ____________ and ____________ ____________ before covering with a dry, sterile dressing.

    d. Slivers and splinters that do not penetrate deeply should be treated as puncture wounds, but splinters that penetrate deeply should be removed by a ____________.

    e. Regardless of severity, all cuts, punctures, and splinter injuries should be treated immediately to avoid ____________.

    f. Depending on the cause of the cut, puncture, or splinter wound, it is usually wise to consider ____________ a hazard.

TEST

19. Complete statements concerning first aid guidelines for workplace burns by inserting the word(s) that best completes each statement.

    a. Notify your ____________ or ____________.

    b. Always treat the victim for ____________.

    c. In the case of a chemical burn, wash off the chemical with large quantities of running water, and ____________ ____________ off the affected area.

    d. In the case of thermal burns, cut away clothing from the area of the burn, but do not try to ____________ material that ____________ to the burn.

    e. With all burns, apply a thick, sterile dressing to prohibit ____________ from reaching the burn.

20. Arrange in order the steps in controlling bleeding by placing the correct sequence number in the appropriate blank.

    _____a. Secure compress with a pressure bandage.

    _____b. Treat for shock.

    _____c. Place a compress of sterile gauze or the cleanest available material directly over the bleeding site.

    _____d. Press firmly with fingers or palm of hand.

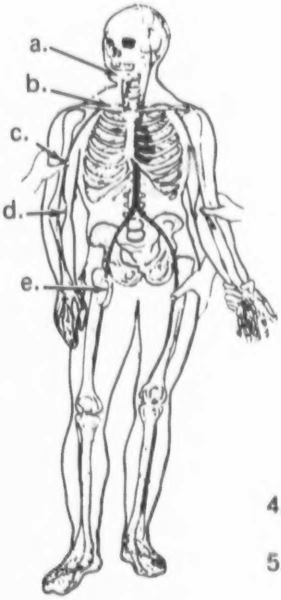
    _____e. If there is a severe life-threatening hemorrhage, AND ONLY AS A LAST RESORT, APPLY A TOURNIQUET.

    _____f. Elevate the bleeding parts above the heart level unless there is evidence of a fracture.

    _____g. If blood soaks through the first compress, place another compress on it, but do not remove the first compress.

TEST

21. Identify pressure points for checking bleeding by placing the correct number in the appropriate blank.



1. Brachial
2. Brachial
3. Facial
4. Subclavian
5. Femoral

22. Complete statements concerning first aid for eye injuries by inserting the word(s) that best completes each statement.

    a. Notify your ____________ or ____________ immediately.

    b. Every eye injury should receive ____________ first aid attention.

    c. For an apparent minor object in the eye, have the person wink several times. If the tears produced by winking do not remove the object, assume that the object is embedded and use the following procedure:

        1) Have the victim ____________ his or her eyes.

        2) Put a piece of ____________ cotton over the closed lid.

        3) Place a ____________ over the cotton.

        4) Get the victim ____________ ____________ ____________ as soon as possible.

    d. When the eyeball has been obviously scratched or penetrated, apply a ____________ dressing, bandage ____________, and get medical help immediately.

TEST

e. Never permit the victim of an eye injury to ____________ his or her eye.

f. When in doubt about any eye injury, seek the most immediate ____________ attention whether it's on the job or in the classroom.

g. Even though damage may be confined to one eye, it is sometimes best to bandage ____________ ____________ with a sterile dressing so the victim will not have a tendency to move the damaged eye.

h. For chemical or acid splashes, flush the eyes ____________ at an eye-flushing station or use a bottled, portable flushing solution, then seek immediate medical assistance.

23. Complete statements concerning general guidelines for first aid emergencies by inserting the word(s) that best completes each statement.

a. Report all accidents and injuries to your instructor or jobsite supervisor, no matter how ____________ they may seem to be.

b. Never ____________ to administer first aid when it is needed.

c. Always have a ____________ for what you do.

d. ____________ the injured person that everything possible is being done.

e. Make accurate notes about the accident including name of victim, time, place, cause or nature of the accident, and any ____________ ____________ that was administered.

f. Do not notify the victim's ____________ because this is the responsibility of the school, the jobsite supervisor, or the medical facility.

g. File a complete ____________ ____________ and submit a copy to the proper persons.

24. Select true statements concerning special rules for eye protection by placing an "X" beside each statement that is true.

_____a. Wear safety glasses only when grinding.

_____b. Wear safety goggles with correct shaded lenses when working with oxyacetylene cutting equipment.

_____c. Wear a welding helmet with proper lens shade when arc welding.

_____d. Wear safety goggles when soldering.

_____e. Wear safety glasses when grinding, and remember that sparks from grinding are dangerous.

_____f. Any form of eye protection should be kept clean so it will not impair the view of materials or the work area.

TEST

25. Select true statements concerning special rules for using compressed air by placing an "X" beside each statement that is true.

_____a. Wear safety glasses when using compressed air.

_____b. Point the air nozzle away from you when using compressed air.

_____c. Make sure fellow workers are clear of the area where the compressed air will blow dirt or debris.

_____d. Beware of hard surfaces that the compressed air could strike and cause debris to ricochet back into your face.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

26. Complete a student safety pledge. (Assignment Sheet #1)

27. Draw a floor plan and locate safety equipment in your shop. (Assignment Sheet #2)

GENERAL SAFETY
UNIT II

ANSWERS TO TEST

1. a. 4
   b. 9
   c. 6
   d. 10
   e. 3
   f. 7
   g. 1
   h. 5
   i. 8
   j. 2

2. a, b, c, d, e, f

3. a. Maintenance
   b. Safe
   c. Condition, act
   d. Traffic hazards

4. A place for everything and everything in its place

5. a. Bench, solid
   b. Toward
   c. Mushroomed
   d. Goggles
   e. Sheet metal
   f. File
   g. Drill press
   h. Face shield
   i. Guards
   j. Molten solder, solder
   k. Acid flux

6. Support the upper torso on the bike and lift with your arms

7. a. Test rides
   b. Safety helmet, protective
   c. Remote, minimum
   d. Bike
   e. Safety, respect

8. b, d, e, g

9. a. Proper
   b. Fuel tank
   c. Fuel system
   d. Fire extinguisher
   e. Helmet, lens, goggles
   f. Gloves, apron
   g. Combustibles
   h. Oil, oil
   i. Battery, battery

ANSWERS TO TEST

10. a. 3
    b. 1
    c. 2

11. a. Yes, water will probably cause the fire to spread. Use a multi-purpose dry chemical fire extinguisher
    b. Look for inspection tags which will indicate when each extinguisher was last inspected and recharged
    c. Direct the spray at the base of the flame

12. a. Yes. Always wear a face shield when servicing a battery
    b. Yes. Always disconnect the negative battery cable first.

13. a. Gasoline
    b. Explosion
    c. Cool off
    d. Heat, open
    e. Toxic
    f. Rubber gloves
    g. Change clothes
    h. Battery acid, acid
    i. Baking soda, baking soda
    j. Motor oil
    k. Motor oil

14. a. Toxic
    b. Splashing
    c. Drip, run
    d. Residue
    e. Compressed air
    f. Face shield
    g. Rubber gloves
    h. Contaminate
    i. Soap, water

15. b, c, e, f

16. a. Pale
    b. Cold
    c. Weak
    d. Rapid
    e. Fast
    f. Confused

17. a. 5
    b. 6
    c. 3
    d. 4
    e. 1
    f. 2

ANSWERS TO TEST

18. a. Supervisor, instructor
    b. Soap, water, sterile
    c. Cleaned, rinsed again
    d. Doctor
    e. Infection
    f. Tetanus

19. a. Supervisor, instructor
    b. Shock
    c. Cut clothing
    d. Remove, adheres
    e. Air

20. a. 5
    b. 6
    c. 1
    d. 2
    e. 7
    f. 3
    g. 4

21. a. 3
    b. 4
    c. 1
    d. 2
    e. 5

22. a. Supervisor, instructor
    b. Immediate
    c. 1) Close
       2) Moist
       3) Bandage
       4) To a doctor
    d. Sterile, loosely
    e. Rub
    f. Medical
    g. Both eyes
    h. Repeatedly

23. a. Minor
    b. Hesitate
    c. Reason
    d. Reassure
    e. First aid
    f. Family
    g. Accident report

ANSWERS TO TEST

24. b, c, d, f
25. a, b, c, d
26. Evaluated to the satisfaction of the instructor
27. Evaluated to the satisfaction of the instructor

TOOLS AND EQUIPMENT
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the basic hand tools, special tools, and major equipment used in a motorcycle service department. The student should also be able to list safety requirements for tool and equipment use and identify selected hand tools, special tools, and major pieces of equipment. These competencies will be evidenced by correctly performing the procedures outlined in the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to tools and equipment with their correct definitions.
2. Identify selected basic hand tools.
3. Match special tools with their uses.
4. Select true statements concerning wheel and tire service equipment.
5. Complete statements concerning major equipment.
6. Select true statements concerning general shop tools.
7. Complete statements concerning tools and equipment care and safety.
8. Identify selected hand tools. (Assignment Sheet #1)
9. Identify selected major equipment. (Assignment Sheet #2)
10. Identify selected general shop tools. (Assignment Sheet #3)

TOOLS AND EQUIPMENT
UNIT III

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information and assignment sheets.

C. Make transparencies.

D. Discuss objective sheet.

E. Discuss information and assignment sheets.

F. Demonstrate the proper use of hand tools such as pulling with a wrench (as opposed to pushing) to avoid getting your knuckles busted, and how to use wrenches in combination when one is required for backup.

G. Invite a motorcycle repair technician from a local or area shop to talk to the students about the tools a technician must own personally and the value of having good quality tools.

H. Read all assignment sheets carefully and place and tag tools as required for students to be properly tested on identification of tools.

I. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. *VoTech HONDA*. Gardena, CA 90247: American Honda Motor Co., Inc., 1983.

(NOTE: The Honda VoTech Training Administrator may be reached at 213-327-8280, Ext. 3000.)

B. *KOWA SEIKI Precision Tools and Equipment* (catalog). Carson, CA 90746: American Kowa Seiki, Inc., 1986.

(NOTE: Outside California, Kowa's toll-free number is 1-800-824-9655; in California the number is 213-327-1713.)

C. *Yamaha Motorcycle Tri-Moto/Generator Special Service Tools* (catalog). Roseville, MI 48066-2298: Kent-Moore Tool Division, 1983.

D. *Snap-On* (catalog). Kenosha, WI 53141-1410: Snap-On Tool Corporation, 1987.

E. *PMS Tools for Big Boys* (catalog). Clearwater, FL 33517: Precision Mfg. and Sales Co., Inc., 1986.

F. *CC Specialty* (catalog). Lawrenceburg, TN 38464: CC Specialty Co., 1985.

TOOLS AND EQUIPMENT
UNIT III

INFORMATION SHEET

I. **Terms and definitions**

A. Cross-hatch finish — The honing of a cylinder wall so that the surface has two smooth parallel finishes that cross at approximately 45° angles

B. Glass beads — A delicate form of cleaning that removes carbon from components without damaging them

C. Pneumatic — A tool or piece of equipment powered with compressed air

D. Solvent — A liquid that dissolves grease, oil, and dirt from parts to speed and improve cleaning

II. **Basic hand tools**

A. Entry-level technicians are usually required to supply their own set of basic tools.

B. The following is a list of minimum basic tool requirements:

1. Flat blade and Phillips-head screwdrivers (Figure 1)
2. Impact driver and impact socket for Phillips-head screws (Figure 1)

FIGURE 1

INFORMATION SHEET

3. Combination wrench set (Figure 2)

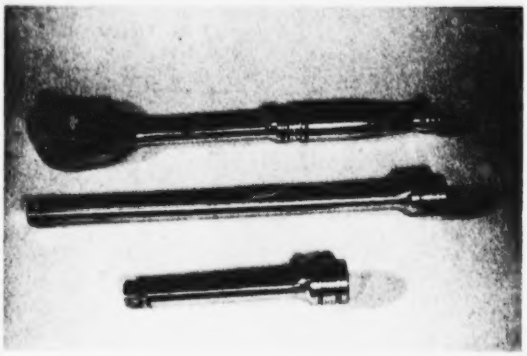
FIGURE 2

4. Shallow and deep socket sets (minimum clearance) (Figure 3)

FIGURE 3

5. Ratchet with 2", 6", and 10" extensions (Figure 4)

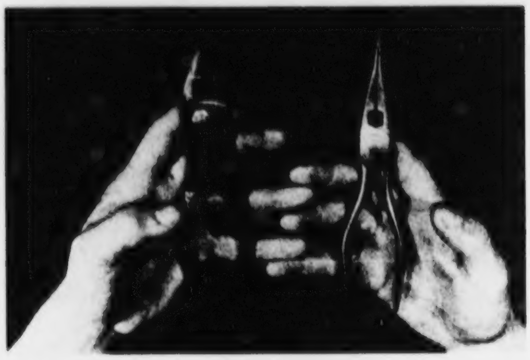
FIGURE 4



INFORMATION SHEET

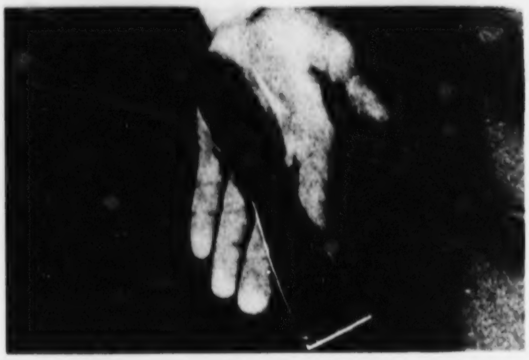
6. Combination slip-joint pliers and needle nose pliers (Figure 5)

FIGURE 5



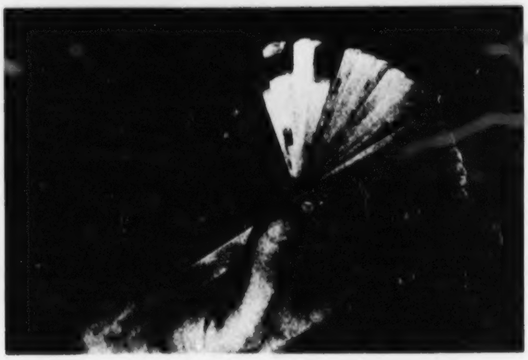
7. Gasket scraper or putty knife (Figure 6)

FIGURE 6



8. Feeler gauge set (Figure 7)

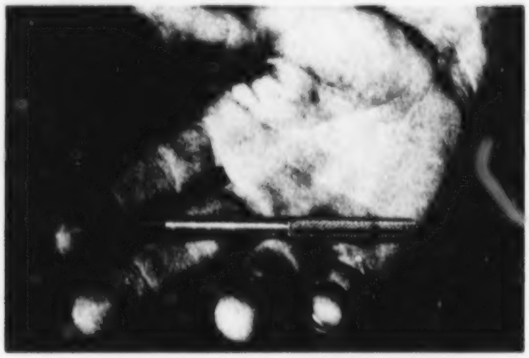
FIGURE 7



INFORMATION SHEET

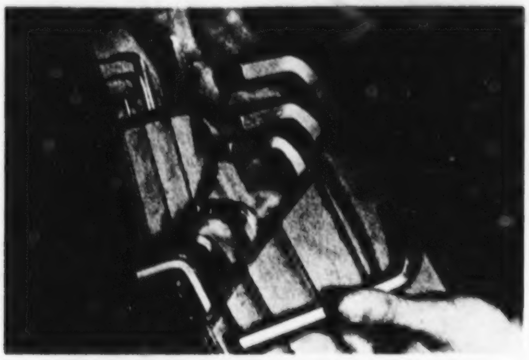
9. Magnetic screw starter (Figure 8)

FIGURE 8



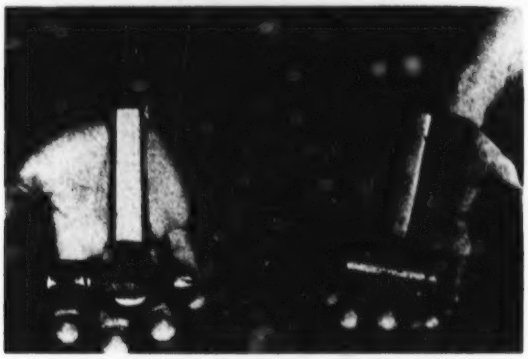
10. Metric allen wrench set (Figure 9)

FIGURE 9



11. Hammer and soft-faced mallet (Figure 10)

FIGURE 10



INFORMATION SHEET

C. Although entry-level technicians may use other tools such as files, hacksaws, chisels and punches, these items are sometimes supplied by the department. (Figure 11)

(NOTE: Naturally, good technicians continue to add needed tools a few at a time as they can conveniently afford to buy them.)

FIGURE 11

D. Pneumatic ratchets and impact guns make certain jobs much easier and faster, and technicians who buy modern equipment find that the tools are really an investment that pays off. (Figure 12)

FIGURE 12

INFORMATION SHEET

III. Special tools and their uses

A. Pullers — Used for removing alternator rotors, bearings, gears, seals, sprockets, and pulleys and flywheels (Figure 13)

FIGURE 13

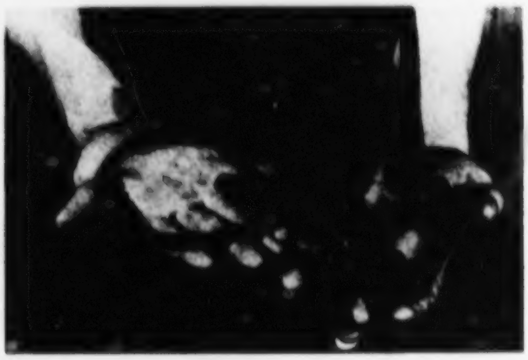
B. Installers — Tools made especially for putting various components into place and are often used to replace components removed by pullers (Figure 14)

FIGURE 14

INFORMATION SHEET

C. Holders — Used as the name implies to hold things like ring gears and clutches while loosening or tightening fasteners (Figure 15)

FIGURE 15

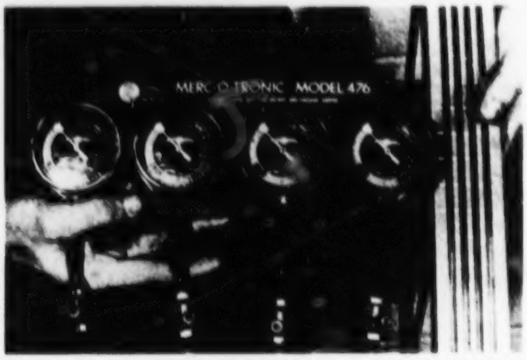


D. Protectors — Used in various shapes and sizes to cover areas of a bike to prevent damage during installation or removal of parts

Example: Fender covers protect painted surfaces

E. Gauges — Used to measure pressure, fluids, torque, and spring pre-loads (Figure 16)

FIGURE 16



INFORMATION SHEET

F. Adapters — Used to help make a single tool function for several purposes (Figure 17)

Example: A compression gauge set has several adapters that will adapt to any spark plug thread for checking compression

FIGURE 17

G. Adjustors — Used for adjusting such things as backlash on a final drive, adjusting valves, and adjusting gear lash (Figure 18)

FIGURE 18

INFORMATION SHEET

H. Compressors — Used generally to compress springs or rings such as valve springs or piston rings (Figure 19)

FIGURE 19

(NOTE: Each manufacturer has special tools that are designed for specific jobs on specific models of motorcycles.)

IV. **Wheel and tire service equipment**

A. Tire changers are the most frequently used pieces of equipment in a service department. (Figure 20)

(NOTE: Most tire changers have adapters so they can be used on both motorcycle and ATV wheels.)

FIGURE 20

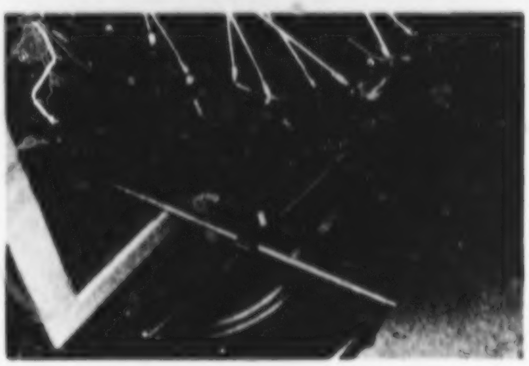
INFORMATION SHEET

B. Wheel balancers are used to properly complete tire repair and assure the tire will perform safely at high speeds. (Figure 21)

FIGURE 21

C. A wheel trueing stand is used to lace and true spoked wheels. (Figure 22)

FIGURE 22



V. **Major equipment**

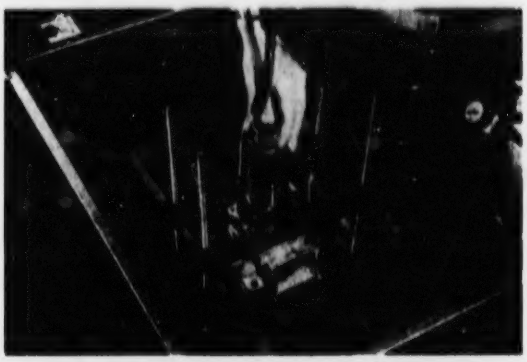
A. A boring bar is used to oversize worn or damaged cylinders. (Figure 23)

FIGURE 23

INFORMATION SHEET

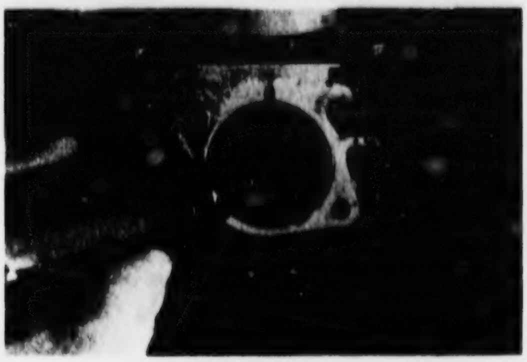
B. Cylinder hones are used to give a smooth, cross-hatch finish to cylinders that have been bored or for finishing a cylinder before piston and rings are installed. (Figure 24)

FIGURE 24



C. A die-grinder is used for chamforing two-cycle ports after boring. (Figure 25)

FIGURE 25



D. Bench grinders are used for sharpening tools, grinding metal, preparing metal surfaces for welding, or for shaping metal surfaces. (Figure 26)

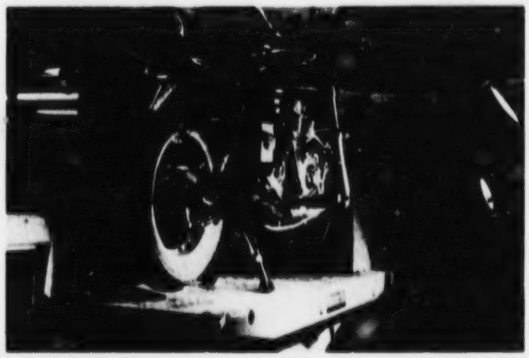
(NOTE: Grinders also have alternative wire wheels and buffers that are used for cleaning and polishing.)

FIGURE 26

INFORMATION SHEET

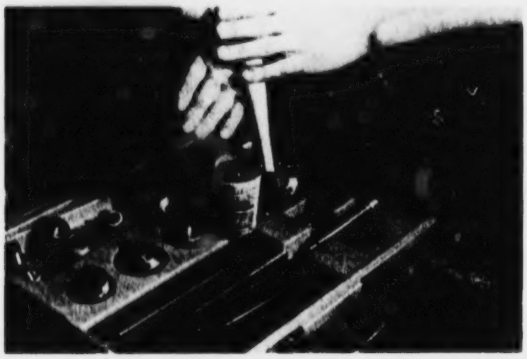
E. A motorcycle lift is used to safely raise a motorcycle to a height it is comfortable to work on. (Figure 27)

FIGURE 27



F. Valve seat reconditioning tools are used expressly for recutting valve seats that have been worn or damaged in the cylinder head. (Figure 28)

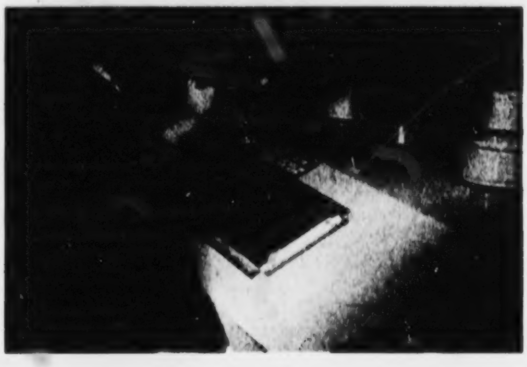
FIGURE 28



G. A glass bead cleaning machine is used to clean parts and is very effective for removing carbon from valves, pistons, and cylinder heads. (Figure 29)

(CAUTION: Glass bead residue must be blown off of parts with compressed air or washed off with soap and water, but glass bead residue should not be washed off with solvent because it will contaminate the solvent.)

FIGURE 29



INFORMATION SHEET

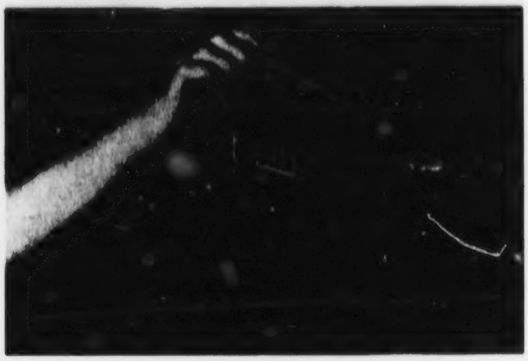
H. Solvent cleaning stations are used to clean oil and grease from parts prior to inspection. (Figure 30)

(NOTE: Parts must be properly cleaned or they cannot be properly inspected.)

FIGURE 30

I. A press is used for straightening forks, disassembly and reassembly of crankshafts, installing bearings, and pressing gears on shafts. (Figure 31)

FIGURE 31



INFORMATION SHEET

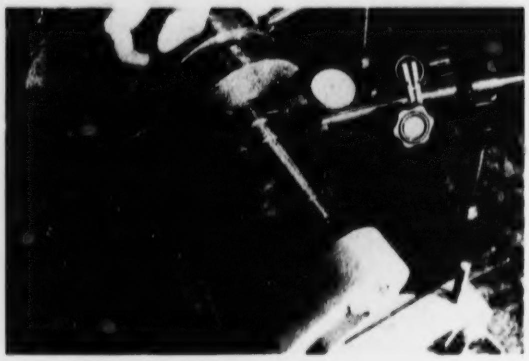
J. A drill press is used for drilling holes as they are needed. (Figure 32)

(CAUTION: Always clamp materials securely when working with a drill press.)

FIGURE 32

K. A crankshaft trueing stand is used to check a crankshaft that is suspected of being bad or a crankshaft that has been rebuilt. (Figure 33)

FIGURE 33

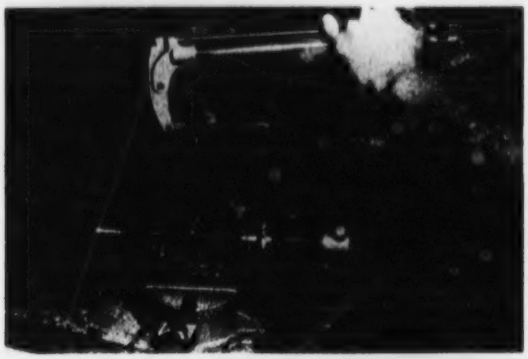


INFORMATION SHEET

VI. General shop tools

A. Bench vises are used for holding, bending, hammering, and shaping a variety of parts and components. (Figure 34)

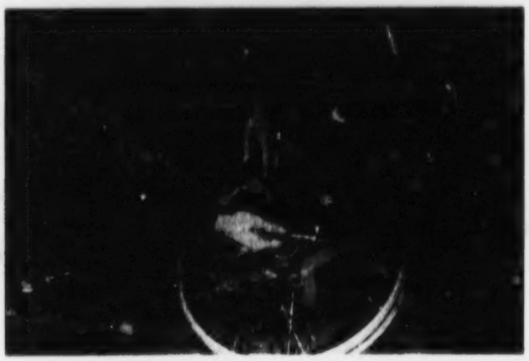
FIGURE 34



B. Most service departments have oxyacetylene cutting equipment for special problems such as cutting off nuts that are seized or frozen on an axle. (Figure 35)

(NOTE: Using a cutting torch is the fastest way to remove spokes from a wheel.)

FIGURE 35



INFORMATION SHEET

C. Air and electric power tools are used around a shop for removing and installing larger bolts and nuts.

VII. **Tool and equipment care and safety**

A. Clean and return all tools to proper storage when you're through with them.

B. Wipe oil or grease from tools before you use them to keep them from slipping out of your hands.

C. Avoid stretching compressed air hoses or extension cords over long distances because they both pose tripping hazards.

D. Make sure guards are in place before using a grinder or drill press and wear a face shield.

E. Bearings being pressed in a press can explode, and since presses do not have guards on them, a face shield is required, and the operator should place a shop towel over the bearing.

(NOTE: The shop towel will not interfere with pressing the bearing into place, and should the bearing explode, the shop towel will usually restrain flying metal pieces enough to avoid operator injury.)

F. Never point a compressed air hose at a fellow worker, and never use compressed air to spin bearings or otherwise use compressed air as a plaything.

(CAUTION: Improper use of compressed air can result in serious injuries, and anytime compressed air is used for cleaning, eye protection is an absolute must.)

G. Never inflate a motorcycle or ATV tire beyond the recommended capacity listed on the sidewall of the tire.

(NOTE: Other elements of tire repair safety will be covered in another unit.)

H. Maintain all tools and equipment to manufacturer's specifications.

TOOLS AND EQUIPMENT
UNIT III

ASSIGNMENT SHEET #1 — IDENTIFY SELECTED HAND TOOLS

Directions: Your instructor has arranged a selection of hand tools and has tagged each tool with a number. Use the following page to write the correct tool name in the appropriate blank.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________
16. ____________________
17. ____________________
18. ____________________
19. ____________________
20. ____________________

Your Name ____________________ Date __________

(NOTE: Use the back of this sheet to add additional numbers as required.)

TOOLS AND EQUIPMENT
UNIT III

ASSIGNMENT SHEET #2 — IDENTIFY SELECTED MAJOR EQUIPMENT

Directions: Your instructor has arranged a selection of major equipment and has tagged each piece with a number. Use the following page to write the correct equipment name in the appropriate blank.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________

Your Name ____________________ Date __________

(NOTE: Use the back of this sheet to add additional numbers as required.)

TOOLS AND EQUIPMENT
UNIT III

ASSIGNMENT SHEET #3 — IDENTIFY SELECTED GENERAL SHOP TOOLS

Directions: Your instructor has arranged a selection of general shop tools and has tagged each piece with a number. Use the following page to write the correct equipment name in the appropriate blank.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________
11. ______________________________
12. ______________________________
13. ______________________________
14. ______________________________
15. ______________________________

Your Name ______________________________ Date ____________

(NOTE: Use the back of this sheet to add additional numbers as required.)

TOOLS AND EQUIPMENT
UNIT III

NAME ____________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. The honing of a cylinder wall so that the surface has two smooth parallel finishes that cross at approximately 45° angles

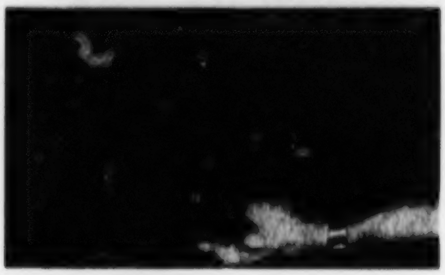
_____b. A delicate form of cleaning that removes carbon from components without damaging them

_____c. A tool or piece of equipment powered with compressed air

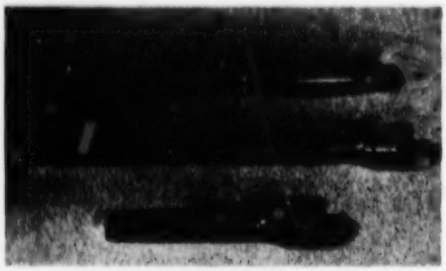
_____d. A liquid that dissolves grease, oil, and dirt from parts to speed and improve cleaning

1. Pneumatic
2. Cross-hatch finish
3. Solvent
4. Glass beads

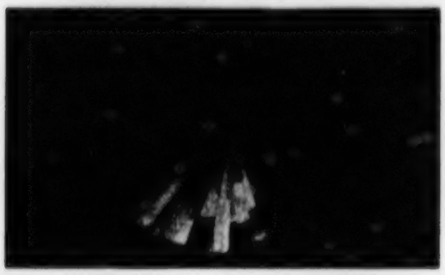
2. Identify basic hand tools by placing the correct tool name below each of the following photographs.



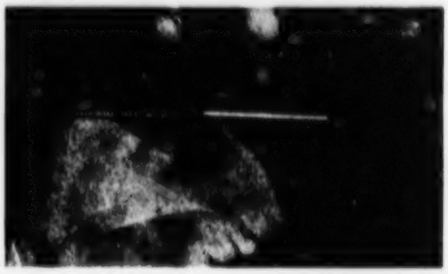
a. ____________________



b. ____________________

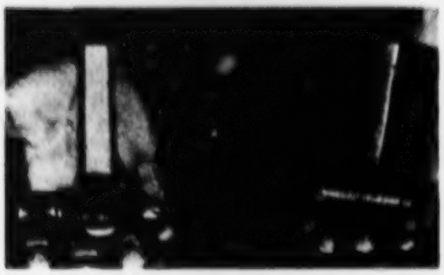


c. ____________________



d. ____________________

TEST



e. ______________________________

f. ______________________________

3. Match special tools with their uses.

_____a. Used for removing alternator rotors, bearings, gears, seals, sprockets, and pulleys and flywheels

_____b. Tools made especially for putting various components into place and are often used to replace components removed by pullers

_____c. Used as the name implies to hold things like ring gears and clutches while loosening or tightening fasteners

_____d. Used in various shapes and sizes to cover areas of a bike to prevent damage during installation or removal of parts

_____e. Used to measure pressure, fluids, torque, and spring pre-loads

_____f. Used to help make a single tool function for several purposes

_____g. Used for adjusting such things as backlash on a final drive, adjusting valves, and adjusting gear lash

_____h. Used generally to compress springs or rings such as valve springs or piston rings

1. Adapters
2. Protectors
3. Gauges
4. Pullers
5. Compressors
6. Holders
7. Adjustors
8. Installers

TEST

4. Select true statements concerning wheel and tire service equipment by placing an "X" beside each statement that is true.

_____a. Tire changes are the most frequently used pieces of equipment in a service department.

_____b. Wheel balancers are used to properly complete tire repair and assure the tire will perform safely at high speeds.

_____c. A wheel balancer is used to balance wheels.

5. Complete statements concerning major equipment by inserting the word(s) that best completes each statement.

a. A ____________ ____________ is used to oversize worn or damaged cylinders.

b. Cylinder ____________ are used to give a smooth, cross-hatch finish to cylinders that have been bored or for finishing a cylinder before piston and rings are installed.

c. A ____________ ____________ is used for chamforing two-cycle ports after boring.

d. Bench ____________ are used for sharpening tools, grinding metal, preparing metal surfaces for welding, or for shaping metal surfaces.

e. A motorcycle ____________ is used to safely raise a motorcycle to a height it is comfortable to work on.

f. Valve ____________ reconditioning tools are used expressly for recutting valve seats that have been worn or damaged in the cylinder head.

g. A ____________ ____________ cleaning machine is used to clean parts and is very effective for removing carbon from valves, pistons, and cylinder heads.

h. ____________ cleaning stations are used to clean oil and grease from parts prior to inspection.

i. A ____________ is used for straightening forks, disassembly and reassembly of crankshafts, installing bearings, and pressing gears on shafts.

j. A ____________ ____________ is used for drilling holes as they are needed.

k. A crankshaft ____________ ____________ is used to check a crankshaft that is suspected of being bad or a crankshaft that has been rebuilt.

TEST

6. Select true statements concerning general shop tools by placing an "X" beside each statement that is true.

_____a. Bench vises are used for holding bending, hammering, and shaping a variety of parts and components.

_____b. Most service departments have propane cutting equipment for special problems such as cutting off nuts that are seized or frozen on an axle.

_____c. Air and electric power tools are seldom used around motorcycle shops.

7. Complete statements concerning tool and equipment care and safety by inserting the word(s) that best completes each statement.

a. Clean and return all tools to proper ____________ when you're through with them.

b. Wipe oil or grease from tools ____________ you use them to keep them from slipping out of your hands.

c. Avoid stretching compressed air hoses or extension cords over long distances because they both pose ____________ hazards.

d. Make sure ____________ are in place before using a grinder or drill press and wear a face shield.

e. Bearings being pressed in a press can explode, and since presses do not have guards on them, a ____________ ____________ is required, and the operator should place a shop towel over the bearing.

f. Never point a compressed air hose at a fellow worker, and never use compressed air to spin bearings or otherwise use compressed air as a ____________.

g. Never inflate a motorcycle or ATV tire beyond the recommended capacity listed on the ____________ of the tire.

h. Maintain ____________ tools and equipment to manufacturer's specifications.

(NOTE: If the following activities have not been completed prior to the test, ask your instructor when they should be completed.)

8. Identify selected hand tools. (Assignment Sheet #1)

9. Identify selected major equipment. (Assignment Sheet #2)

10. Identify selected general shop tools. (Assignment Sheet #3)

TOOLS AND EQUIPMENT
UNIT III

ANSWERS TO TEST

1. a. 2
   b. 4
   c. 1
   d. 3

2. a. Combination wrench set
   b. Ratchet with extensions
   c. Feeler gauge set
   d. Magnetic screw starter
   e. Hammer and soft-faced mallet
   f. Metric allen wrench set

3. a. 4
   b. 8
   c. 6
   d. 2
   e. 3
   f. 1
   g. 7
   h. 5

4. a, b, c

5. a. Boring bar
   b. Hones
   c. Die-grinder
   d. Grinders
   e. Lift
   f. Seat
   g. Glass bead
   h. Solvent
   i. Press
   j. Drill press
   k. Trueing stand

6. a, c

7. a. Storage
   b. Before
   c. Tripping
   d. Guards
   e. Face shield
   f. Plaything
   g. Sidewall
   h. All

8.-10. Evaluated to the satisfaction of the instructor

METRIC MEASUREMENTS
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the need for metric measurement in motorcycle and ATV work and identify metric measuring tools. The student should also be able to measure selected workpieces with a caliper, a metric micrometer, a telescoping gauge, and a small bore gauge as well as measure runout and verify timing with a dial indicator. These competencies will be evidenced by correctly completing the procedures outlined in the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to metric measurements with their correct definitions.
2. Complete statements concerning metric measurements.
3. Complete statements concerning metric prefixes.
4. Solve problems concerning units of metric measurement.
5. Identify metric measuring instruments.
6. Solve problems concerning using a metric outside micrometer.
7. Complete statements concerning reading a metric micrometer.
8. Solve problems concerning using a telescoping gauge.
9. Solve problems concerning using a small bore gauge.
10. Complete statements concerning using a dial bore gauge.
11. Select true statements concerning using vernier or dial calipers.
12. Complete statements concerning using a dial indicator.

OBJECTIVE SHEET

13. Read a metric micrometer. (Assignment Sheet #1)

14. Demonstrate the ability to:

    a. Measure selected workpieces with a vernier caliper. (Job Sheet #1)

    b. Measure selected workpieces with a metric micrometer. (Job Sheet #2)

    c. Measure runout and verify timing with a dial indicator. (Job Sheet #3)

    d. Measure a cylinder bore with a telescoping gauge. (Job Sheet #4)

    e. Measure selected workpieces with a small bore gauge. (Job Sheet #5)

METRIC MEASUREMENTS
UNIT IV

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Demonstrate proper measuring techniques.

H. Show wear limit specifications from several selected points in a service manual and talk with students about the importance of accuracy in measuring.

I. Impress upon students the importance of selecting the proper measuring instrument for the component being measured.

J. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. *Product Catalog.* Cleveland, OH 44130: Parts Associates, Inc., 1986.

C. *AMI Metric Industrial & Automotive Catalog.* Troy, MI 48084: American Machinery Importers, Inc.

METRIC MEASUREMENTS
UNIT IV

INFORMATION SHEET

I. **Terms and definitions**

   A. Increments — The quantity by which a graduated scale is increased or decreased

   B. TDC (top dead center) — The position of a piston at its highest point in a cylinder

   C. BTDC (before top dead center) — The position of a piston at a point between halfway up and TDC

   D. Lateral runout — The degree to which a wheel wobbles back and forth as it turns

   E. Radial runout — The degree to which a wheel moves up and down from a center axle as it turns

II. **Metric measurements**

   A. Most motorcycles and ATV's are manufactured using metric measurements.

   B. Good technicians must be familiar with the basics of metric measurement in order to use metric measuring tools and in order to understand many specifications in service manuals.

   C. The metric system is based on units of 10, and anyone who can count to 10 can use the metric system with accuracy.

   D. Basic units of the metric system are:

      1. Meter for length

      2. Kilogram for weight

      3. Liter for volume

   E. The metric system uses a selection of prefixes for the convenience of multiplying or dividing base units by multiples of 10 so that hundreds and thousands can be quickly expressed by moving a decimal point.

   Example: 1 mm = .03937 inches
   10 mm = .3937 inches
   100 mm = 3.937 inches
   1000 mm = 39.37 inches

INFORMATION SHEET

III. **Metric prefixes**

A. Metric prefixes are used to identify multiples or divisions of base units in increments of ten, one hundred, one thousand, or one million.

B. Prefixes that multiply base units are (Transparency 1):

1. Deca = 10
2. Hecto = 100
3. Kilo = 1,000

C. Prefixes that divide base units are (Transparency 1):

1. Deci = 1/10th
2. Centi = 1/100th
3. Milli = 1/1000th

IV. **Units of metric measurement**

A. Millimeters, abbreviated mm, are used to measure lengths, cylinder bores, and to determine clearances.

(NOTE: A millimeter is 1/1000th of a meter and is equal to .03937 inches.)

B. Cubic centimeters, abbreviated cc, are used to measure fluids and engine displacements.

(NOTE: A cubic centimeter is 1/1000th of a liter, and 1 cc equals .061 cubic inches.)

C. Kilograms, abbreviated kg, are used to measure weight.

(NOTE: A kilogram equals 2.2046 pounds.)

D. Kilograms per centimeter squared, abbreviated kg/cm^2, are used to measure pressures in tires and radiators.

(NOTE: One kg/cm^2 equals 14.223 lbs. per square inch, PSI.)

E. Kilograms per meter, abbreviated kg-m, are used to measure torque, and Newton meters, abbreviated Nm, are used for smaller torque measurements.

(NOTE: The kg-m and Nm measurements are equal to foot/lbs and inch/lbs in U.S. measurement.)

INFORMATION SHEET

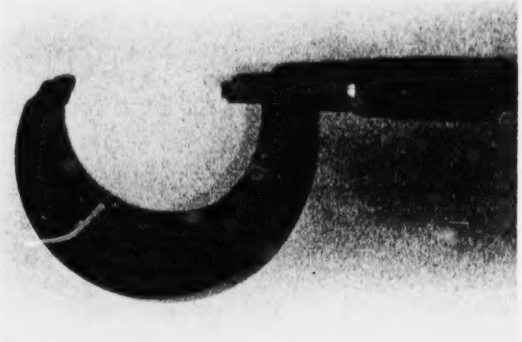
F. Liters, abbreviated l (little L), are used to measure oils and other fluids.

(NOTE: A liter is equal to 1.0567 U.S. quarts.)

V. **Metric measuring instruments**

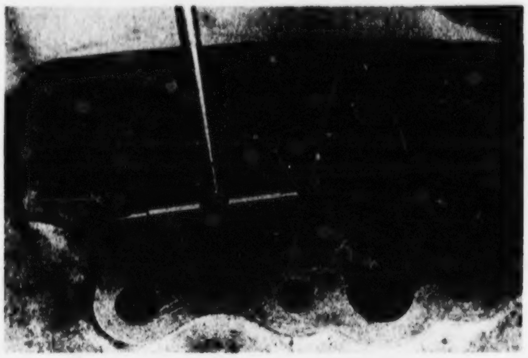
A. The measuring instrument most often used around motorcycles and ATV's is the outside micrometer. (Figure 1)

FIGURE 1



B. Two other frequently used tools are the telescoping gauge used to measure inside diameters, and the small hole gauge used to measure smaller diameters; both of these instruments must be used in conjunction with an outside micrometer. (Figure 2)

FIGURE 2



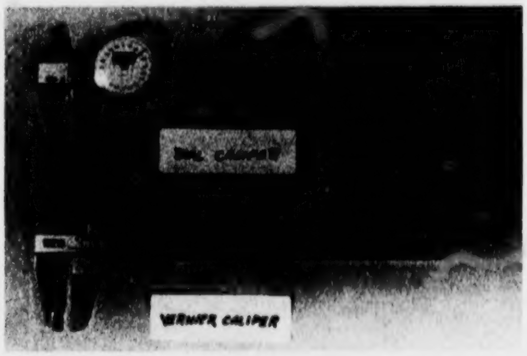
INFORMATION SHEET

C. Dial bore gauges must be calibrated with an outside micrometer and are used to check for wear and taper in cylinder bores. (Figure 3)

FIGURE 3

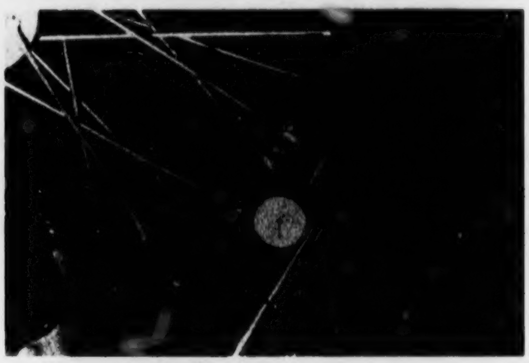
D. Dial calipers or vernier calipers are used for a variety of measuring activities where precision is not critical. (Figure 4)

FIGURE 4



E. Dial indicators are used to measure lateral and radial runout on shafts, brake rotors, wheels, and piston position relative to ignition timing. (Figure 5)

FIGURE 5



INFORMATION SHEET

F. Thread and bolt measuring sets are used to measure thread pitch and diameter of fasteners. (Figure 6)

FIGURE 6

VI. **Using a metric outside micrometer**

A. Metric micrometers are designed to measure distances in increments of 25 mm, and usually come in sets of four.

Example: O mm to 25 mm, 25 mm to 50 mm, 50 mm to 75 mm, and 75 mm to 100 mm

B. Always select the micrometer graduated for the distance you anticipate you'll be measuring.

C. Make sure the micrometer is accurate by using a standard micrometer test gauge to obtain a zero reference.

Example: To check a 50 mm to 75 mm micrometer, place a 50 mm test gauge between the spindle and anvil and turn the thimble down as far as it will go; if the thimble and sleeve reading is zero, the micrometer is accurate.

D. Steps in measuring with an outside micrometer include:

1. Place the workpiece to be measured between the anvil and spindle.
2. Turn the thimble until it makes light contact with the workpiece.
3. Move the micrometer back and forth to obtain a slight drag at the point of the largest diameter on the workpiece.
4. Read the thimble reading and the sleeve reading and add the two, and then add that figure to the base value of the micrometer.

Example: A reading of 20 mm on a 50 mm to 75 mm micrometer would be the sleeve and thimble reading of 20 mm plus the base value reading of 50 mm for a total of 70 mm.

INFORMATION SHEET

VII. **Reading a metric micrometer** (Transparencies 2 and 3)

A. Sleeve readings on metric micrometers are in graduations of .5 mm with the top numbers in 5 mm increments.

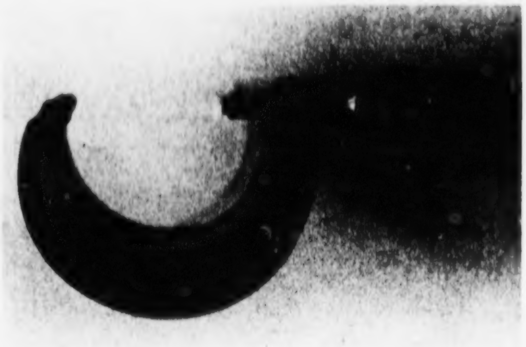
B. Lines below the index line on the sleeve indicate .5 mm increments.

C. Lines above the index line on the sleeve indicate 1 mm increments.

D. Numbers on the spindle are in increments of .05 mm, and each single line represents .01 mm.

Example: In the following illustration, the sleeve reading is 10 mm and the thimble reading is .42 mm, so the two added together give a reading of 10.42 mm which would be the reading on a 0 mm to 25 mm micrometer.

FIGURE 7



VIII. **Using a telescoping gauge**

A. Telescoping gauges are most commonly used to measure cylinder bores or other inside dimensions.

B. Telescoping gauges have no measuring graduations and must themselves be measured with an outside micrometer.

C. Steps in using a telescoping gauge include:

1. Loosen the nut on the end of the handpiece.
2. Compress the telescoping ends until they are small enough to fit into the bore being measured.
3. Tilt the gauge slightly in-line with its axis, not to one side.
4. Loosen the nut on the handpiece and allow the telescoping gauge to extend until it touches both sides of the bore.

INFORMATION SHEET

5. Lightly tighten the nut on the handpiece.

6. Keep one side of the gauge stationary and bring the other side up in a slight arcing movement to allow the second side to seek the maximum diameter of the bore.

7. Remove the gauge slowly with one continuous motion, but don't stop in the middle of the bore.

8. Remove the gauge and measure it carefully with an outside micrometer, but do not overtighten the micrometer and force the telescoping legs in.

IX. Using a small bore gauge

A. As the name implies, small bore gauges are used to measure small holes or small bores such as valve guides.

B. Small bore gauges do not have measuring graduations and must themselves be measured with an outside micrometer.

C. Steps in using a small bore gauge include:

1. Turn the nut on the handpiece counterclockwise until the gauge will fit inside the bore to be measured.

2. Work the handpiece up and down while turning the nut clockwise on the handpiece until a slight drag develops.

3. Remove the small bore gauge and measure it carefully with an outside micrometer.

X. Using a dial bore gauge

A. Dial bore gauges are used to accurately measure cylinder bores for wear and taper.

B. A dial bore gauge has to be calibrated with an outside micrometer.

C. Distance pieces and bushings of specific lengths have to be assembled onto the gauge to obtain the highly accurate measurements that dial bore gauges are used for.

D. The following procedure is a handy one for using a dial bore gauge to measure out of round and taper:

1. Put the dial bore into the bore at the bottom or top.

2. Zero the dial and check the bore in six places.

3. Each measurement made in the bore will reference the zero mark on the dial and indicate how far above or below the original measurement the rest of the bore is.

INFORMATION SHEET

XI. **Using vernier or dial calipers**

A. Vernier or dial calipers are used for measurements that do not have to be precise, measurements such as clutch springs, clutch discs, or bolt lengths.

B. Vernier or dial calipers will measure from 0 mm to 150 mm which makes them a tool versatile enough for many uses, and they will also measure inside, outside, and depth measurements.

C. Steps in using vernier or dial calipers include:

1. Open the jaws of the caliper slightly wider than the workpiece to be measured.
2. Turn the thumb wheel to lightly close the jaws onto the workpiece.
3. Lock the caliper with the locking screw.
4. Remove the caliper from the workpiece.
5. With a dial caliper, add the dial reading to the frame reading to determine the size of the workpiece.
6. With a vernier caliper, add the vernier reading to the frame reading for correct measurement.

XII. **Using a dial indicator**

A. Dial indicators are used almost exclusively to measure lateral or radial runout on wheels, brake rotors, crankshafts, and fork tubes.

B. Dial indicators can also be used to determine the position that a piston is in with relation to top dead center for ignition timing.

C. Steps in using a dial indicator to check runout include:

1. Secure the dial indicator to a stationary base.
2. Preload the indicator and zero the dial.
3. Turn the workpiece and observe the movement of the dial to determine the amount of radial or lateral runout.

D. Steps in using a dial indicator to check piston position include:

1. Secure the dial indicator to a stationary base with the contact point directly over and parallel with the piston.
2. Turn the crankshaft and move the piston to the top of its stroke.

INFORMATION SHEET

3. Align the zero mark on the dial with the dial needle.

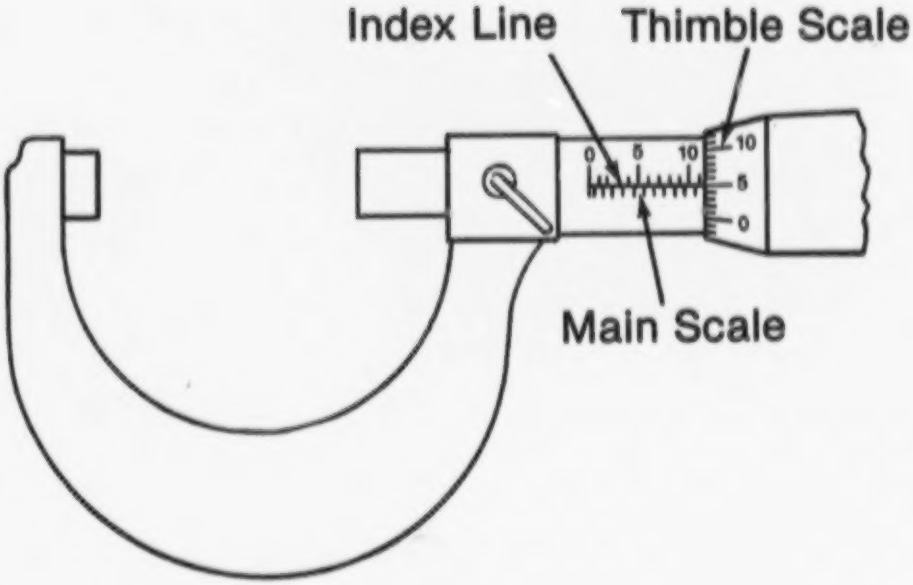
4. Turn the crankshaft backwards from normal rotation and move the piston down to the desired point.

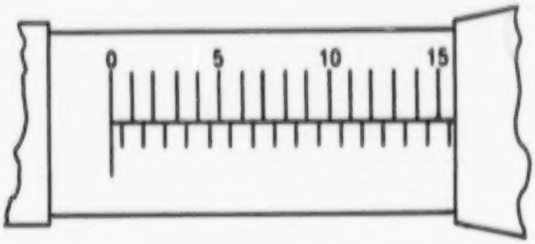
   (NOTE: The firing point will usually be before top dead center and will be in the range of .8 mm to 2.5 mm; ignition timing on some two-stroke engines must be accomplished by using a dial indicator.)

Metric Prefixes

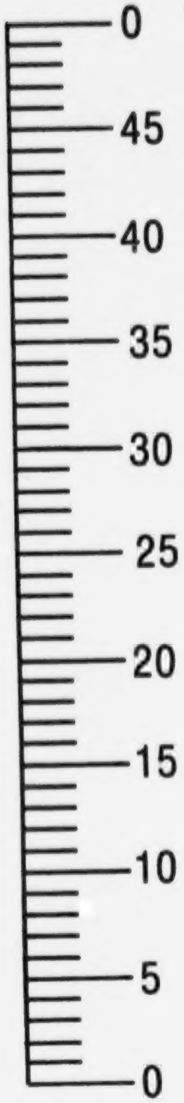
1 000 000 = 10^6	mega	M	one million
1 000 = 10^3	kilo	k	one thousand
100 = 10^2	hecto	h	one hundred
10 = 10	deka	da	ten
0.1 = 10^{-1}	deci	d	one tenth
0.01 = 10^{-2}	centi	c	one hundredth
0.001 = 10^{-3}	milli	m	one thousandth
0.000 001 = 10^{-6}	micro	μ	one millionth

Sleeve Readings


Index Line
Thimble Scale
0
5
10
10
5
0
Main Scale



Thimble Readings

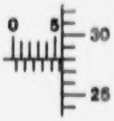

0
45
40
35
30
25
20
15
10
5
0

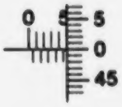
METRIC MEASUREMENTS
UNIT IV

ASSIGNMENT SHEET #1 — READ A METRIC MICROMETER

Directions: Examine the following illustrations of metric micrometers and record the reading as indicated.

A. 0 mm to 25 mm micrometer:

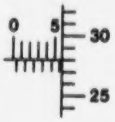


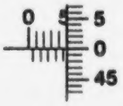


1. ______________________________

2. ______________________________

B. 25 mm to 50 mm micrometer:

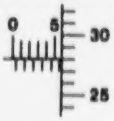


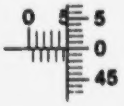


1. ______________________________

2. ______________________________

C. 50 mm to 75 mm micrometer:

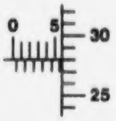


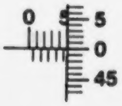


1. ______________________________

2. ______________________________

D. 75 mm to 100 mm micrometer:





1. ______________________________

2. ______________________________

YOUR NAME ______________________________ SCORE ____________

METRIC MEASUREMENTS
UNIT IV

ANSWERS TO ASSIGNMENT SHEET

A. 1. 5.78 mm

2. 5.00 mm

B. 1. 30.78 mm

2. 30.00 mm

C. 1. 55.78 mm

2. 55.00 mm

D. 1. 80.78 mm

2. 80.00 mm

METRIC MEASUREMENTS
UNIT IV

JOB SHEET #1 — MEASURE SELECTED WORKPIECES WITH A VERNIER CALIPER

A. Tools and materials

1. Vernier caliper
2. Assortment of drill bits numbered for reference
3. Assortment of clutch springs and discs numbered for reference
4. Assortment of round stock numbered for reference
5. Assortment of sockets numbered for reference
6. Clean shop towel
7. Pencil
8. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Clean the appropriate faces of the caliper as you make the following different measurements for outside diameter, inside diameter, and depth.
3. Zero the caliper.
4. Open the caliper for making an outside measurement on the workpiece you have selected.
5. Close the jaws of the caliper lightly against the workpiece and tighten the locking screw. (Figure 1)

FIGURE 1

JOB SHEET #1

6. Remove the caliper carefully.

7. Read the caliper and record the measurement on the Caliper Measurement Log that accompanies this job sheet.

8. Repeat the procedure for other workpieces to be measured for outside diameter and record your measurements in the appropriate place on the log that accompanies this job sheet.

9. Close the inside jaws of the caliper for making inside diameter measurements on the first workpiece you have selected.

10. Open the jaws of the caliper lightly against the workpiece and tighten the locking screw. (Figure 2)

FIGURE 2

11. Remove the caliper carefully.

12. Read the caliper and record the measurement on the Caliper Measurement Log that accompanies this job sheet.

13. Repeat the procedure for other workpieces to be measured for inside diameter, and record your measurements in the appropriate place on the log.

14. Prepare the caliper for making a depth measurement on the workpiece you have selected.

JOB SHEET #1

15. Run the caliper out a bit farther than the depth you intend to measure. (Figure 3)

FIGURE 3

16. Place the depth gauge into or beside the workpiece, and then grasp the body of the caliper and push it down until it contacts the surface of the workpiece. (Figure 4)

FIGURE 4

17. Tighten the locking screw and carefully remove the depth gauge.

18. Read the caliper and record the measurement on the Caliper Measurement Log that accompanies this job sheet.

19. Repeat the procedure for other workpieces to be measured for depth, and record your measurement in the appropriate places on the log.

☐ Hand your log in to your instructor for evaluation.

17. Clean up area and return tools and materials to proper storage.

JOB SHEET #1

Caliper Measurement Log

A. 1. ______________________

2. ______________________

3. ______________________

4. ______________________

B. 1. ______________________

2. ______________________

3. ______________________

4. ______________________

C. 1. ______________________

2. ______________________

3. ______________________

4. ______________________

YOUR NAME ______________________________ DATE __________

METRIC MEASUREMENTS
UNIT IV

JOB SHEET #2 — MEASURE SELECTED WORKPIECES WITH A METRIC MICROMETER

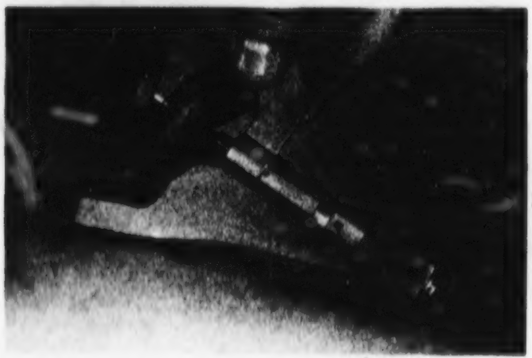
A. Tools and materials

1. Set of metric micrometers, 0 mm to 25 mm, 25 mm to 50 mm, 50 mm to 75 mm, and 75 mm to 100 mm
2. Assortment of workpieces such as pistons, piston pins, shafts, or an assortment of drill bits numbered for reference
3. Pencil
4. Clean shop towel
5. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Select the proper size micrometer for the workpiece you intend to measure.
3. Clean the spindle and anvil of the micrometer with a clean shop towel. (Figure 1)

FIGURE 1

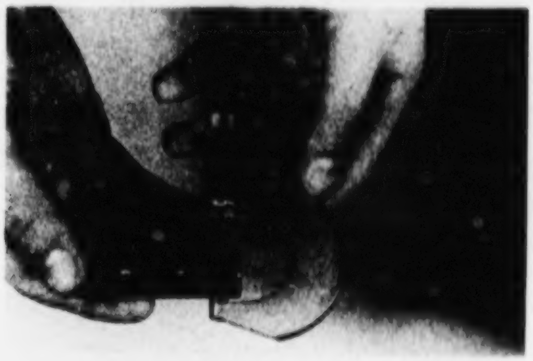


4. Zero the micrometer.

JOB SHEET #2

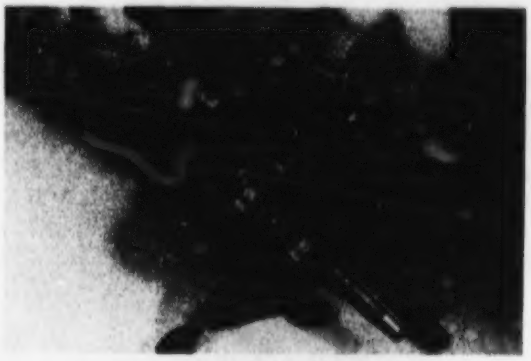
5. Hold the micrometer in one hand and the workpiece in your other hand when measuring small objects such as pistons or piston pins. (Figure 2)

FIGURE 2



6. Hold the micrometer with both hands when measuring heavier objects such as crankshafts. (Figure 3)

FIGURE 3



7. Roll the micrometer gently along the palm of your hand or up your forearm to quickly open it up so it'll be large enough to fit over the workpiece. (Figure 4)

FIGURE 4

JOB SHEET #2

8. Place the micrometer directly over the center of the workpiece to be measured.

9. Turn the thimble until the anvil and spindle contact the workpiece.

10. Hold the anvil steady and work the spindle back and forth lightly to find the true diameter of the workpiece. (Figure 5)

FIGURE 5

11. Use the ratchet stop or trust to your sense of feel to obtain an exact measurement.

12. Record your first finding in the appropriate place on the measurement log that accompanies this job sheet.

13. Repeat the procedure on all remaining workpieces.

☐ Hand your log in to your instructor for evaluation.

14. Clean up area and return tools and materials to proper storage.

JOB SHEET #2

Outside Micrometer Measurement Log

A. 0 mm to 25 mm outside micrometer:

1. ______
2. ______
3. ______
4. ______

B. 25 mm to 50 mm outside micrometer:

1. ______
2. ______
3. ______
4. ______

C. 50 mm to 75 mm outside micrometer:

1. ______
2. ______
3. ______
4. ______

D. 75 mm to 100 mm outside micrometer:

1. ______
2. ______
3. ______
4. ______

YOUR NAME ______ DATE ______

METRIC MEASUREMENTS
UNIT IV

JOB SHEET #3 — MEASURE RUNOUT AND VERIFY TIMING WITH A DIAL INDICATOR

A. Tools and materials

1. Dial indicator, finger type
2. Dial indicator, plunger type
3. Motorcycle wheel
4. V-blocks
5. Fork tubes
6. Crankshaft
7. Wheel trueing stand
8. Motorcycle as selected by instructor (with 2-stroke engine)
9. Clean shop towels
10. Pencil
11. Motorcycle timing gauge set
12. Safety glasses

B. Routine #1 — Using a dial indicator to verify timing

1. Put on safety glasses.
2. Secure the motorcycle in an upright position.
3. Remove the flywheel cover.
4. Remove the cylinder head, if required.

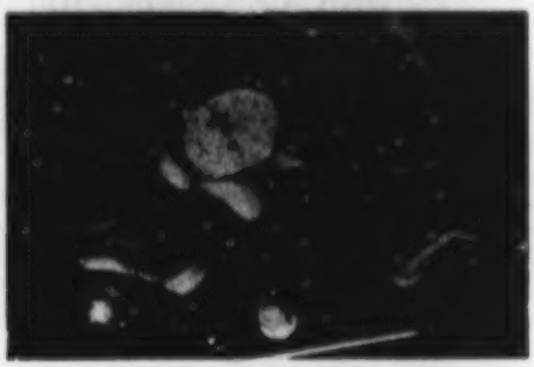
   (NOTE: If you're working with an engine that has a spark plug that goes straight into the cylinder head, you can accomplish this routine by removing the spark plug and installing the timing gauge adapter.)

5. Turn the flywheel to position the piston near TDC (top dead center).

JOB SHEET #3

6. Mount the dial indicator in a stationary position so that the plunger extends down into the cylinder and contacts the top of the piston. (Figure 1)

FIGURE 1



7. Preload the dial indicator so that it will measure more distance than you anticipate you'll be measuring.

8. Watch the dial on the dial indicator as you turn the flywheel back and forth.

9. Turn the face of the dial indicator so that the needle on the dial aligns with the zero on the scale when the piston is at TDC.

10. Turn the flywheel so that the engine turns backwards slightly past the point of ignition timing, and then turn the engine back to the ignition timing point.

    (NOTE: If the engine times at 1.8 mm BTDC, first turn it to 2.0 mm BTDC, then back to 1.8 mm BTDC.)

11. Check to make sure the points open when the engine is at the proper ignition timing point, or that the F mark aligns with the index mark on the engine.

    (NOTE: Adjusting timing may require turning the backing plate slightly or adjusting the point gap.)

☐ Have your instructor check your work.

C. Routine #2 — Using a dial indicator to check lateral runout on a motorcycle wheel

1. Leave your safety glasses on.

2. Position the motorcycle wheel in a trueing stand.

JOB SHEET #3

3. Mount the dial indicator on the arm of the trueing stand. (Figure 2)

FIGURE 2

4. Preload the dial indicator.

5. Turn the wheel to make sure there is enough preload to measure wheel runout.

6. Zero the dial indicator at either the high or low runout point and continue checking for lateral runout.

   (NOTE: Brake rotor runout can be checked with this same procedure except that the dial indicator should be fastened to the fork leg or the motorcycle frame.)

☐ Have your instructor check your work.

D. Routine #3 — Using a dial indicator to check radial runout on a front fork tube

1. Leave your safety glasses on.

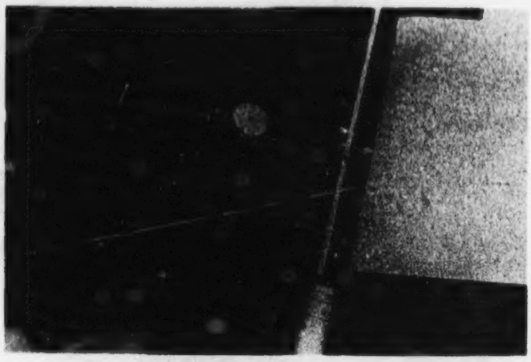
2. Lay the fork tube down so that each end is supported by a V-block.

3. Mount the dial indicator securely to a base.

JOB SHEET #3

4. Position the dial indicator so that it contacts the approximate center point of the fork tube. (Figure 3)

FIGURE 3



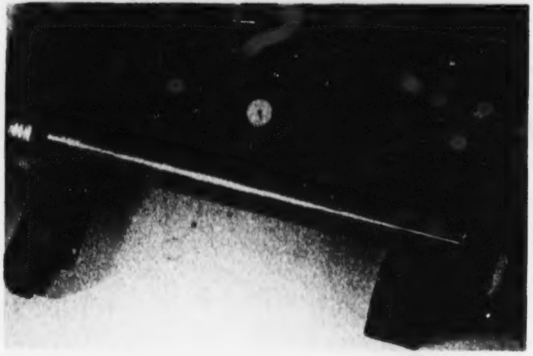
5. Preload the dial indicator so that it will measure more than the anticipated distance.

6. Turn the fork tube in the V-blocks to the maximum high point, and zero the dial at that point.

7. Turn the fork tube to determine the amount of radial runout in the fork tube.

8. Move the dial indicator to different points on the fork tube to find the exact point where the fork tube is bent. (Figure 4)

FIGURE 4



☐ Have your instructor check your work.

9. Clean up area and return tools and materials to proper storage.

METRIC MEASUREMENTS
UNIT IV

JOB SHEET #4 — MEASURE A CYLINDER BORE WITH A TELESCOPING GAUGE

A. Tools and materials

1. Cylinder as selected by instructor
2. Telescoping gauge
3. Outside micrometer set
4. Clean shop towel
5. Pencil
6. Safety glasses

B. Procedure

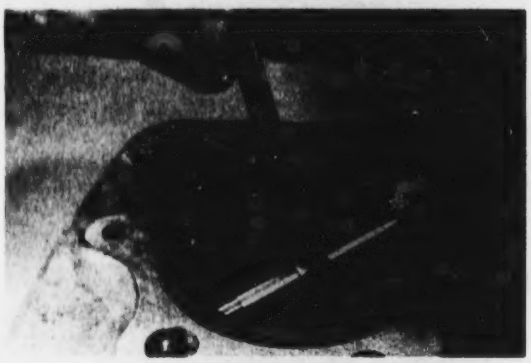
1. Put on safety glasses.
2. Wipe the cylinder bore clean with a shop towel.
3. Wipe both ends of the telescoping gauge clean with a shop towel.
4. Loosen the nut on the end of the handpiece of the gauge.
5. Compress the telescoping ends until they're small enough to fit into the cylinder bore.
6. Tighten the nut lightly to keep the ends from springing out.
7. Tilt the gauge slightly in-line with its axis, not to one side. (Figure 1)

FIGURE 1

JOB SHEET #4

8. Loosen the nut on the handpiece and allow the ends of the gauge to extend out until they touch the sides of the cylinder. (Figure 2)

FIGURE 2



9. Tighten the nut on the handpiece lightly.

10. Keep one side of the gauge stationary and bring the other side up in an arcing movement to allow the second side to seek the maximum diameter of the bore. (Figure 3)

    (NOTE: The objective here is to bring the gauge out in one continuous motion because stopping at any point would not give the maximum diameter.)

FIGURE 3

JOB SHEET #4

11. Remove the gauge and measure it carefully with an outside micrometer, but do not overtighten the micrometer and force the telescoping legs in. (Figure 4)

FIGURE 4

12. Measure the first cylinder in three places, top, middle, and bottom, in line with the crankshaft. (Figure 5)

FIGURE 5

13. Measure the first cylinder in three places, top, middle, and bottom, at 90° to the crankshaft. (Figure 6)

FIGURE 6

JOB SHEET #4

14. Record all of your measurements in the Cylinder Bore Measurement Log that accompanies this job sheet.

15. Repeat the procedure for other cylinders.

☐ Have your instructor check your work.

16. Clean up area and return tools and materials to proper storage.

JOB SHEET #4

Cylinder Bore Measurement Log

1. Cylinder #1:

	at 90°	In-line
Top		
Middle		
Bottom		

2. Cylinder #2:

	at 90°	In-line
Top		
Middle		
Bottom		

3. Cylinder #3:

	at 90°	In-line
Top		
Middle		
Bottom		

4. Cylinder #4:

	at 90°	In-line
Top		
Middle		
Bottom		

YOUR NAME ______________________________ DATE ____________

METRIC MEASUREMENTS
UNIT IV

PRACTICAL TEST #1
JOB SHEET #1 — MEASURE SELECTED WORKPIECES WITH A VERNIER CALIPER

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Cleaned the caliper.	2.	☐	☐
3. Zeroed the caliper.	3.	☐	☐
4. Measured properly.	4.	☐	☐
5. Read caliper properly.	5.	☐	☐
6. Recorded reading on log.	6.	☐	☐
7. Measured depth properly.	7.	☐	☐

EVALUATOR'S COMMENTS: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

METRIC MEASUREMENTS
UNIT IV

PRACTICAL TEST #2
JOB SHEET #2 — MEASURE SELECTED WORKPIECES WITH A METRIC MICROMETER

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:			YES	NO
1.	Wore safety glasses.	1.	☐	☐
2.	Selected proper micrometer.	2.	☐	☐
3.	Cleaned spindle and anvil.	3.	☐	☐
4.	Zeroed the micrometer.	4.	☐	☐
5.	Measured small objects properly.	5.	☐	☐
6.	Measured large objects properly.	6.	☐	☐
7.	Recorded measurements on log.	7.	☐	☐
8.	Used 0 mm to 25 mm micrometer properly	8.	☐	☐
9.	Used 25 mm to 50 mm micrometer properly.	9.	☐	☐
10.	Used 50 mm to 75 mm micrometer properly.	10.	☐	☐
11.	Used 75 mm to 100 mm micrometer properly.	11.	☐	☐

EVALUATOR'S COMMENTS: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

METRIC MEASUREMENTS
UNIT IV

PRACTICAL TEST #3
JOB SHEET #3 — MEASURE RUNOUT AND VERIFY TIMING WITH A DIAL INDICATOR

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Secured vehicle safely.	2.	☐	☐
3. Removed flywheel cover and cylinder head.	3.	☐	☐
4. Set flywheel so piston was near TDC.	4.	☐	☐
5. Positioned dial indicator properly into cylinder.	5.	☐	☐
6. Preloaded the dial indicator properly.	6.	☐	☐
7. Checked to make sure points opened at proper time.	7.	☐	☐
8. Positioned wheel in trueing stand.	8.	☐	☐
9. Mounted dial indicator properly.	9.	☐	☐
10. Preloaded dial indicator properly.	10.	☐	☐
11. Properly measured lateral wheel runout.	11.	☐	☐
12. Prepared fork tube.	12.	☐	☐
13. Positioned dial indicator properly.	13.	☐	☐
14. Preloaded dial indicator.	14.	☐	☐
15. Zeroed indicator a maximum fork high point.	15.	☐	☐
16. Properly determined radio runout of fork tube.	16.	☐	☐
17. Identified point where fork tube was bent.	17.	☐	☐

EVALUATOR'S COMMENTS: ____

____

____

JOB SHEET #3 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

METRIC MEASUREMENTS
UNIT IV

PRACTICAL TEST #4
JOB SHEET #4 — MEASURE A CYLINDER BORE WITH A TELESCOPING GAUGE

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Cleaned the cylinder bore.	2.	☐	☐
3. Cleaned the telescoping gauge.	3.	☐	☐
4. Compressed the gauge ends properly.	4.	☐	☐
5. Tightened nut to keep ends from springing out.	5.	☐	☐
6. Tilted gauge slightly in-line with axis.	6.	☐	☐
7. Measured cylinder properly.	7.	☐	☐
8. Removed gauge with proper continuous arcing motion.	8.	☐	☐
9. Measured gauge properly with outside micrometer.	9.	☐	☐
10. Measured cylinder in-line with crankshaft in three places.	10.	☐	☐
11. Measured cylinder 90° to crankshaft in three places.	11.	☐	☐
12. Recorded all measurements on log.	12.	☐	☐

EVALUATOR'S COMMENTS: ____

____

____

JOB SHEET #4 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

METRIC MEASUREMENTS
UNIT IV

NAME ____________________

TEST

1. Match the terms on the right with their correct definitions.

    _____a. The quantity by which a graduated scale is increased or decreased

    _____b. The position of a piston at its highest point in a cylinder

    _____c. The position of a piston at a point between halfway up and TDC

    _____d. The degree to which a wheel wobbles back and forth as it turns

    _____e. The degree to which a wheel moves up and down from a center axle as it turns

    1. Lateral runout
    2. BTDC
    3. Increments
    4. Radial runout
    5. TDC

2. Complete statements concerning metric measurements by inserting the word(s) or number(s) that best completes each statement.

    a. Most motorcycles and ATV's are manufactured using ____________ measurements.

    b. Good technicians must be familiar with the basics of metric measurement in order to use metric measuring tools and in order to understand many ____________ in service manuals.

    c. The metric system is based on units of ____________, and anyone who can count to ____________ can use the metric system with accuracy.

    d. Basic units of the metric system are:

        1) ____________ for length

        2) ____________ for weight

        3) ____________ for volume

    e. The metric system uses a selection of prefixes for the convenience of multiplying or dividing base units by multiples of ____________ so that hundreds and thousands can be quickly expressed by moving a ____________ point.

TEST

3. Complete statements concerning metric prefixes by inserting the word(s) or number(s) that best completes each statement.

   a. Metric prefixes are used to identify multiples or divisions of base units in increments of ____________, one ____________, one ____________, or one ____________.

   b. Prefixes that multiply base units are:

      1) ____________ = 10

      2) ____________ = 100

      3) ____________ = 1,000

   c. Prefixes that divide base units are:

      1) ____________ = $^1/_{10}$th

      2) ____________ = $^1/_{100}$th

      3) ____________ = $^1/_{1000}$th

4. Solve problems concerning units of metric measurement by answering the following questions correctly.

   a. When measuring the length of a cylinder bore, what unit of metric measurement would you use?

      Answer ____

   b. When measuring torque on a fastener, what unit of metric measurement would you use?

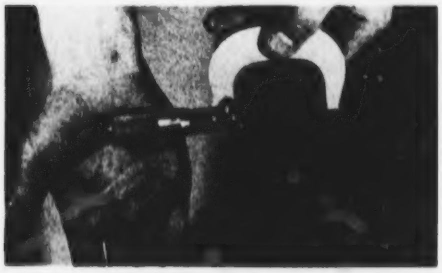
      Answer ____

   c. When measuring a quantity of oil, what unit of metric measurement would you use?

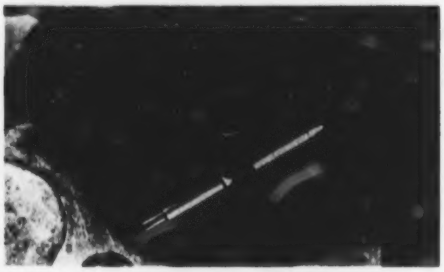
      Answer ____

TEST

5. Identify metric measuring instruments by inserting the correct instrument name beneath the appropriate photograph.



a. ______________________________



b. ______________________________

c. ______________________________

d. ______________________________

6. Solve the following problems concerning using a metric outside micrometer.

   a. You are getting ready to measure with an outside microcometer, and you need to know whether or not it is accurate; how would you check the micrometer for accuracy?

      Answer ______________________________

      ____

   b. You have just finished measuring a piston pin with an outside micrometer; how do you arrive at a reading?

      Answer ______________________________

      ____

TEST

7. Complete statements concerning reading a metric micrometer by inserting the number(s) that best completes each statement.

   a. Sleeve readings on metric micrometers are in graduations of .5 mm with the top numbers in ____________ mm increments.

   b. Lines below the index line on the sleeve indicate ____________ mm increments.

   c. Lines above the index line on the sleeve indicate ____________ mm increments.

   d. Numbers on the spindle are in increments of .05 mm, and each single line represents ____________ mm.

8. Solve the following problems concerning using a telescoping gauge.

   a. You have just completed a cylinder measurement with a telescoping gauge; how do you get your final reading?

      Answer ____

      ____

   b. You have just completed a bore measurement with a telescoping gauge and want to remove the gauge; how should the gauge be removed?

      Answer ____

      ____

9. Solve the following problems concerning using a small bore gauge.

   a. You have just finished measuring a rod end with a small bore gauge; how do you get your final reading?

      Answer ____

      ____

   b. You have turned the small bore gauge nut counterclockwise to fit it into the bearing you are measuring, and you turn the nut clockwise when you start to make your measurement, but what other activity is required to make an accurate measurement?

      Answer ____

      ____

TEST

10. Complete statements concerning using a dial bore gauge by inserting the word(s) that best completes each statement.

    a. Dial bore gauges are used to accurately measure cylinder bores for ____________ and ____________.

    b. A dial bore gauge has to be ____________ with an outside micrometer.

    c. ____________ and ____________ of specific lengths have to be assembled onto the gauge to obtain the highly accurate measurements that dial bore gauges are used for.

    d. The following procedure is a handy one for using a dial bore gauge to measure out of round and taper:

        1) Put the dial bore into the bore at the ____________ or ____________.

        2) ____________ the dial and check the bore in six places.

        3) Each measurement made in the bore will reference the ____________ mark on the dial and indicate how far above or below the original measurement the rest of the bore is.

11. Select true statements concerning using vernier or dial calipers by placing an "X" in front of the true statements.

    (NOTE: For a statement to be true, all parts of the statement must be true.)

    _____a. Vernier or dial calipers are used for measurements that have to be precise, measurements such as clutch springs, clutch discs, or bolt lengths.

    _____b. Vernier or dial calipers will measure from 0 mm to 150 mm which makes them a tool versatile enough for many uses, and they will also measure inside, outside, and depth measurements.

    _____c. Steps in using vernier or dial calipers include:

        1) Open the jaws of the caliper slightly smaller than the workpiece to be measured.

        2) Turn the thumb wheel to lightly close the jaws onto the workpiece.

        3) Lock the caliper with the locking screw.

        4) Remove the caliper from the workpiece.

        5) With a vernier caliper, add the dial reading to the frame reading to determine the size of the workpiece.

        6) With a vernier caliper, add the vernier reading to the frame reading for correct measurement.

TEST

12. Complete statements concerning using a dial indicator by inserting the word(s) that best completes each statement.

    a. Dial indicators are used almost exclusively to measure ____________ or ____________ runout on wheels, brake rotors, crankshafts, and fork tubes.

    b. Dial indicators can also be used to determine the position that a ____________ is in with relation to top dead center for ignition timing.

    c. Steps in using a dial indicator to check runout include:

        1) Secure the dial indicator to a ____________ base.

        2) Preload the ____________ and zero the dial.

        3) Turn the workpiece and observe the movement of the dial to determine the amount of ____________ or ____________ runout.

    d. Steps in using a dial indicator to check piston position include:

        1) Secure the dial indicator to a stationary base with the ____________ ____________ directly over and parallel with the piston.

        2) Turn the ____________ and move the piston to the top of its stroke.

        3) Align the zero mark on the dial with the ____________ ____________.

        4) Turn the ____________ backwards from normal rotation and move the piston down to the desired point.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

13. Read a metric micrometer. (Assignment Sheet #1)

14. Demonstrate the ability to:

    a. Measure selected workpieces with a dial caliper. (Job Sheet #1)

    b. Measure selected workpieces with a metric micrometer. (Job Sheet #2)

    c. Measure runout and verify timing with a dial indicator. (Job Sheet #3)

    d. Measure a cylinder bore with a telescoping gauge. (Job Sheet #4)

    e. Measure selected workpieces with a small bore gauge. (Job Sheet #5)

METRIC MEASUREMENTS
UNIT IV

ANSWERS TO TEST

1. a. 3
   b. 5
   c. 2
   d. 1
   e. 4

2. a. Metric
   b. Specifications
   c. 10, 10
   d. 1) Meter
      2) Kilogram
      3) Liter
   e. 10, decimal

3. a. Ten, hundred, thousand, million
   b. 1) Deca
      2) Hecto
      3) Kilo
   c. 1) Deci
      2) Centi
      3) Milli

4. a. Meter or millimeters
   b. Kilograms per meter
   c. Liter or milliliter

5. a. Outside micrometer
   b. Telescoping gauge
   c. Thread and bolt measuring set
   d. Dial bore gauge

6. a. By using a standard micrometer test gauge
   b. Add the thimble and sleeve readings, and then add the base value of the micrometer

7. a. 5
   b. .5
   c. 1
   d. .01

8. a. Measure the gauge with an outside micrometer
   b. Slowly with a continuous motion, and without stopping in the middle of the bore

9. a. Measure the gauge with an outside micrometer
   b. Work the handpiece up and down until a slight drag develops

ANSWERS TO TEST

10. a. Wear, taper
    b. Calibrated
    c. Distance pieces, bushings
    d. 1) Bottom, top
       2) Zero
       3) Zero

11. b

12. a. Lateral, radial
    b. Piston
    c. 1) Stationary
       2) Indicator
       3) Radial, lateral
    d. 1) Contact point
       2) Crankshaft
       3) Dial needle
       4) Crankshaft

13. Evaluated to the satisfaction of the instructor

14. Performance skills evaluated with practical tests

FASTENERS
UNIT V

UNIT OBJECTIVE

After completion of this unit, the student should be able to measure metric fasteners and identify nuts, bolts, washers, snap-rings, and special fasteners. The student should also be able to sketch a tightening sequence for a selected component and repair damaged threads with a thread repair kit and remove a broken bolt with a screw extractor set. These competencies will be evidenced by correctly completing the procedures outlined in the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms related to fasteners with their correct definitions.
2. Complete statements concerning metric bolts and nuts.
3. Solve a problem concerning measuring metric bolts and threads.
4. Complete a list of qualities of satisfactory fasteners.
5. Identify typical fasteners.
6. Identify typical bolt head styles.
7. Identify typical nuts.
8. Identify special purpose nuts with locking or self-locking features.
9. Identify types of washers.
10. Identify devices for locking nuts or bolts.
11. Identify types of screw head designs.
12. Identify types of snap rings.
13. Complete statements concerning special fasteners.
14. Complete a list of methods used to remove a seized nut.

OBJECTIVE SHEET

15. Solve problems concerning repairing threads.

16. Complete statements concerning adhesives and sealers.

17. Solve problems concerning loosening and tightening fasteners.

18. Draw the tightening sequence and list torque values for a selected component from a service manual. (Assignment Sheet #1)

19. Demonstrate the ability to:

    a. Repair damaged threads using a thread repair kit. (Job Sheet #1)

    b. Remove a broken bolt using a screw extractor set. (Job Sheet #2)

FASTENERS
UNIT V

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Dicuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Demonstrate other techniques for removing broken fasteners.

H. Review oxyacetylene torch use and safety in case students need to use a torch for Job Sheet #2.

I. Impress upon students that too much heat on an aluminum component will melt the aluminum.

J. Stress the importance of drilling a straight center hole when removing a broken bolt.

K. Demonstrate how threading is accomplished with tap and die sets.

L. Demonstrate how to set a torque wrench and use it to torque different types of fasteners to specified torque values.

M. Demonstrate torquing sequences on a variety of engines and components.

N Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Product Catalog.* Cleveland, OH 44130: Parts Associates, Inc., 1986.

B. *AMI Metric Industrial & Automotive Catalog.* Troy, MI 48084: American Machinery Importers, Inc.

FASTENERS
UNIT V

INFORMATION SHEET

I. **Terms and definitions**

A. Bolt — A metal rod with threads on one end and a head on the other

B. Nut — A small metal block with a threaded hole in the center for screwing onto a bolt

C. Screw — A cylindrical piece of metal threaded so it penetrates a material as it is rotated

D. Fastener — A device used to secure or hold things together

E. Stud — A steel rod with threads on both ends so that one end can be permanently fixed and a nut can be screwed on the other end

F. Tap — A tool for cutting internal threads

G. Die — A tool for cutting external threads

H. Banjo fitting — A fitting that permits variable positioning of a fluid line and permits fluid flow through a partially hollow bolt

I. Thread pitch — The number of threads per mm on a bolt, nut, or screw

J. Tensile strength — The capacity of a piece of metal to resist pulling apart

II. **Metric bolts and nuts** (Figure 1)

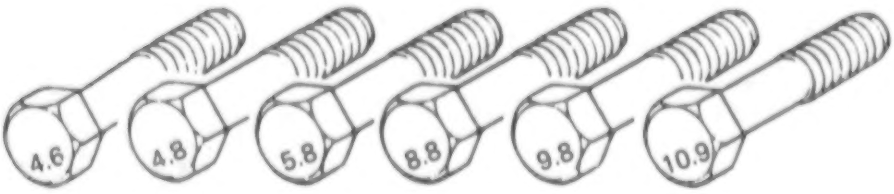
A. Metric bolts are marked by numbers which indicate grade and tensile strength.

B. The higher the number the stronger the bolt.

C. The most common replacement bolt for motorcycles and ATV's is grade 8.8 which is strong enough for almost all bolt requirements except special applications.

D. Special metric bolts do not have grade markings, but they do have part numbers.

FIGURE 1



INFORMATION SHEET

E. Metric bolts and nuts should always be torqued according to their diameter, pitch, and grade or to specifications outlined in service manuals.

F. The following chart is an example of torque values for grade 8.8, 10.9, and 12.9 bolts and nuts, and can be used if no torque value information is otherwise available. (Figure 2)

FIGURE 2

GRADE		NOMINAL DIAMETER								
		M 4	M 5	M 6	M 7	M 8	M 10	M 12	M 14	M 16
8.8	kpm	0.29	0.57	1	1.6	2.5	5	8	13	20
	Pound-Feet	2	4	7	11	18	32	58	94	144
10.9	kpm	0.4	0.8	1.4	2.3	3.5	6	12	18	27
	Pound-Feet	2.9	6	10	16	25	47	83	133	196
12.9	kpm	0.5	1	1.6	2.7	4	8	14	22	33
	Pound-Feet	3.6	7	11	20	29	58	100	159	235

III. **Measuring metric bolts and threads** (Transparency 1)

A. The size of a bolt is determined by measuring the diameter of the threaded end.

B. The length of a bolt is determined by measuring the distance from the bottom of the head to the end of the threads.

C. The number of threads per mm is determined by measuring with a metric thread gauge.

(NOTE: With experience you will develop the ability to recognize thread pitch and size by looking at the fastener, but length almost always has to be measured.)

IV. **Qualities of satisfactory fasteners**

A. Strong

B. Reusable

C. Easy to remove

D. Withstand vibration

E. Long lasting

F. Corrosion resistant

G. Temperature resistant

INFORMATION SHEET

V. **Typical fasteners** (Transparency 2)

A. Hex head bolt

B. Wing nut

C. Stud

D. Woodruff key

E. Cap screw

F. Socket head bolt

G. Tapping screw

H. Tooth lock washer

I. Rivet

J. Bolt and nut

K. Cotter pin

L. Square key

M. Flat washer

N. Carriage bolt

O. Castle nut

P. Lock washer

Q. Adhesive

R. Lock pin

S. Snap ring

T. Machine screw

U. Set screw

V. Spring lock pin

W. Locking nut

X. Clevis pin

INFORMATION SHEET

VI. **Typical bolt head styles** (Transparency 3)

- A. Hex head bolt
- B. Hex socket head bolt
- C. 12-point head bolt
- D. Carriage bolt
- E. Hex flange bolt

VII. **Typical nuts** (Transparency 4)

- A. Acorn
- B. Castle
- C. Spring
- D. Wing
- E. Hex
- F. Flanged
- G. Lock
- H. Slotted
- I. Panel

VIII. **Special purpose nuts with locking or self-locking features** (Transparency 5)

- A. Prevailing torque lock nut
- B. Plastic insert lock nut
- C. Jam nut
- D. Castle nut
- E. Slotted nut
- F. Wing nut
- G. Chamfered nut
- H. Cap nut
- I. Flange-lock nut

INFORMATION SHEET

IX. **Types of washers** (Transparency 6)

  A. Flat washer

  B. Lock washer

  C. External toothed lock washer

  D. Internal toothed lock washer

  E. Countersunk external toothed washer

X. **Devices for locking nuts or bolts** (Transparency 7)

  A. Cotter pins

  B. Lockwire

  C. Flat metal locks

  D. Lock ears

XI. **Types of screw head designs** (Transparency 8)

  A. Pan

  B. Oval

  C. Cross recessed or Phillips

  D. Flat

  E. Hex slotted

  F. Torx

XII. **Types of snap rings** (Transparency 9)

  A. Internal prong

  B. Internal hole

  C. External hole

  D. External "E"

  E. Wire-Type

INFORMATION SHEET

XIII. **Special fasteners** (Transparency 10)

A. Shouldered bolts are used to provide a fixed distance between two parts to provide a pivot point or to prevent overtightening.

B. Reduction studs have threads of different sizes on each end and are used to provide additional strength by using a larger diameter thread when a stud is screwed into aluminum or when there is limited depth in the component.

Example: Reduction studs are used on some cylinder heads because there is limited depth available in the aluminum casting yet the extra strength is needed because the cylinder is subjected to extreme heat and high pressures.

C. Chrome-headed or chrome-plated bolts are used to enhance the appearance of the vehicle.

D. Many fasteners use a rolled-on thread rather than a cut thread to provide clearance around bolts and studs for oil passages.

E. Banjo oil fittings use a bolt that has a hole drilled part way through the bolt from the threaded end, and another hole drilled into the side of the bolt so oil can pass through.

F. Motorcycles and ATV's purposely use high-quality bolts and fasteners that are designed for specific applications such as extra strength, appearance, capacity to stretch, or unique shape.

G. Special fasteners always have part numbers, and these part numbers should be used to assure that replacement fasteners duplicate the originals.

XIV. **Methods used to remove a seized nut** (Transparency 11)

A. Penetrating oil

B. Hacksaw

C. Nut splitter

D. Chisel

E. Gas torch

INFORMATION SHEET

XV. Repairing threads

A. Some threads on motorcycles and ATV's have a special pitch to provide additional pressure with limited torque.

B. Threads having a special pitch are almost impossible to repair so always handle such fasteners with care.

C. Left-handed threads are sometimes used on turning or spinning parts to prevent loosening from centrifugal force or friction.

D. Tools for repairing left-handed metric threads are difficult to find, so always handle fasteners with left-handed threads with care.

E. Threads in aluminum parts are easily damaged and overtightening bolts that screw into aluminum should be avoided at all times.

F. There are several brands of thread repair kits that make repairing stripped or damaged threads in aluminum parts a relatively easy task.

G. Tools commonly used for thread repair include (Transparency 12):

1. A thread file which has eight different thread pitches on it, and is used for external thread damage.
2. Rethreading dies are sometimes used to restore external threads, but they must be used with care or existing good threads farther down can be easily damaged.
3. Hand taps are used to restore internal threads, but they must be used with care or existing good threads farther down can be easily damaged.
4. External thread chasers are used to restore damaged threads on bolts or studs when the damage is not too severe.
5. Internal thread chasers are used to restore damaged threads in internal threads.

INFORMATION SHEET

XVI. Adhesives and sealers

A. Adhesives and sealers are almost never required with gaskets because gaskets that need to be sealed come with sealer already applied.

B. Nonhardening sealers are sometimes used on oil and crankcase seals to make installation easier and to insure a positive seal.

C. Center case joints that do not use gaskets are always sealed with a heat-resistant, nonhardening sealer such as Yamabond, Kawasaki Seal, Suzuki Seal, or Honda Seal.

D. Some bolts require a locking adhesive to prevent them from loosening under extreme pressure, excessive heat, or to prevent oil leaks.

Example: Bottom fork leg bolts almost always require an adhesive as well as proper torquing.

XVII. Loosening and tightening fasteners

A. Nuts and bolts that secure cylinder heads, engine cases, or other components almost always have to be loosened and tightened in a sequence that will assure proper distribution of pressure and avoid damage to the component.

B. Never remove cylinder heads when they're hot because the heat can cause the head to warp and ruin it.

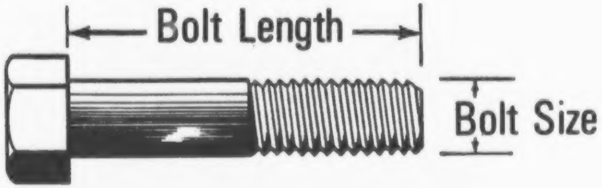
C. Bolts and nuts should not be torqued completely down at one time, but torqued in small steps so the whole assembly is pulled down evenly.

Example: On a cylinder head, the first step is to snug all the bolts down lightly, make sure the head is seating flat, and then tighten bolts in sequence about half their recommended torque; follow the sequence again and torque the bolts to specified value, and then recheck all bolts because as final bolts are torqued down they may cause bolts that were torqued first to loosen slightly.

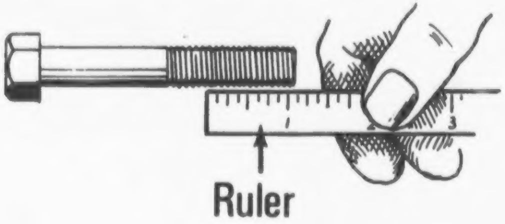
D. If no sequence for tightening bolts is given in the service manual, there are some general guidelines for sequence:

1. Start with center bolts first, then work in patterns of X's from the center to the outside and toward each end.
2. On components secured with different size fasteners, loosen small fasteners first and tighten small fasteners last.

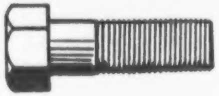
How to Measure Bolts and Threads


Bolt Length
Bolt Size

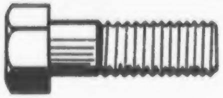
Measure Threads per CM and Divide by Ten



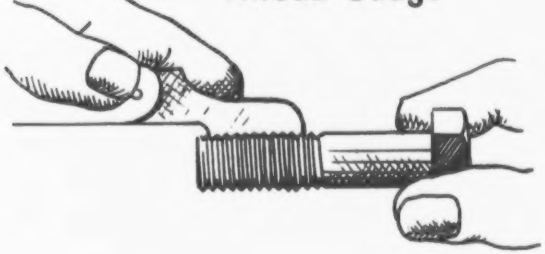
Fine Thread



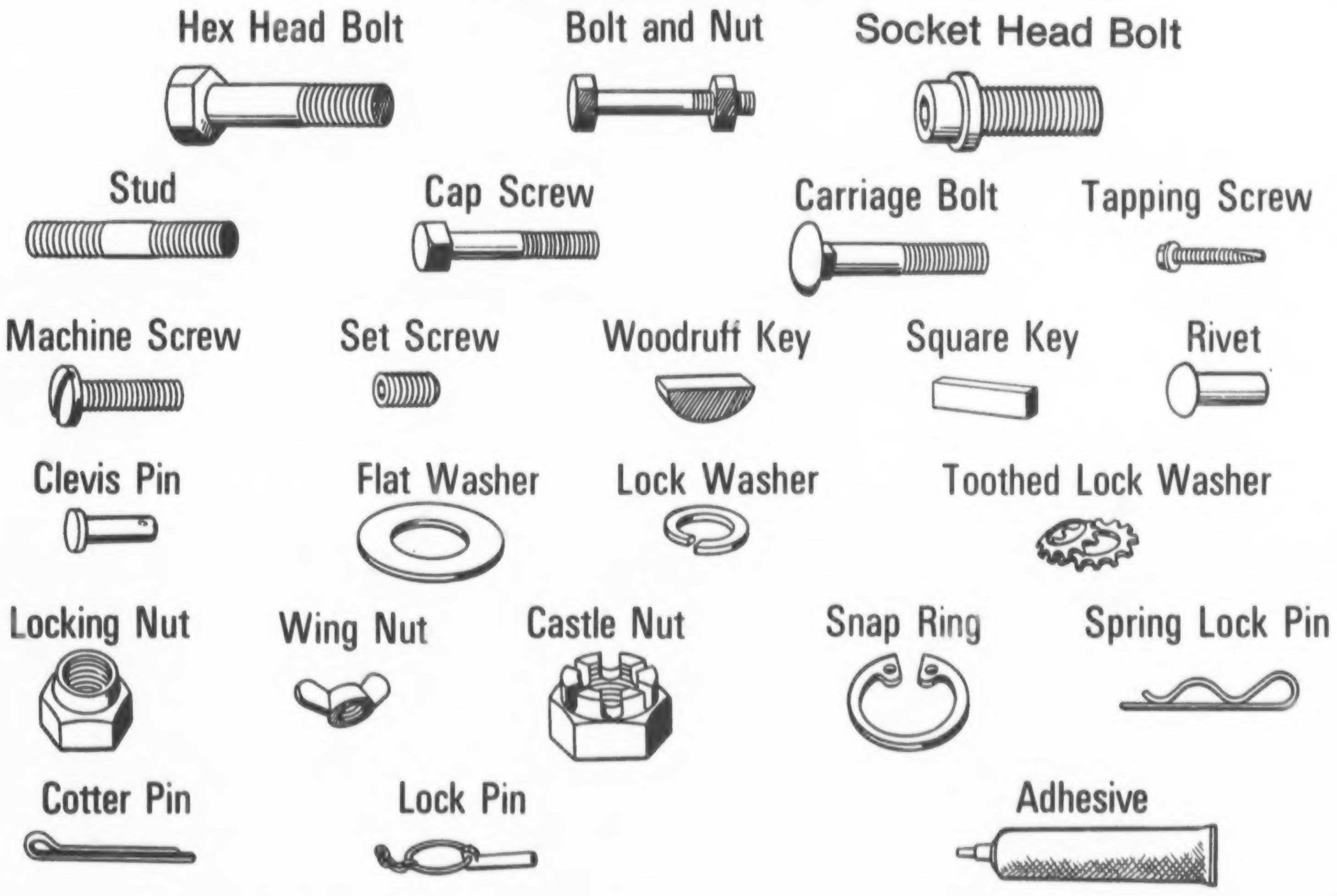
Coarse Thread



Thread Gauge

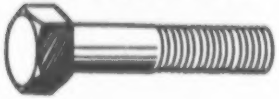


Typical Fasteners

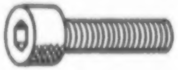

Hex Head Bolt
Bolt and Nut
Socket Head Bolt
Stud
Cap Screw
Carriage Bolt
Tapping Screw
Machine Screw
Set Screw
Woodruff Key
Square Key
Rivet
Clevis Pin
Flat Washer
Lock Washer
Toothed Lock Washer
Locking Nut
Wing Nut
Castle Nut
Snap Ring
Spring Lock Pin
Cotter Pin
Lock Pin
Adhesive

Bolt Head Styles

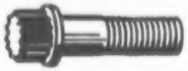
Hex Head Bolt



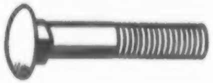
Hex Socket Head Bolt



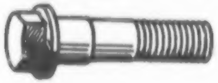
12-Point Head Bolt



Carriage Bolt

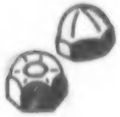


Hex Flange Bolt

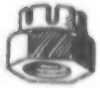


Typical Nuts

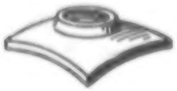
Acorn



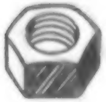
Castle



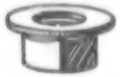
Spring



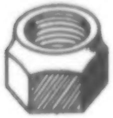
Hex



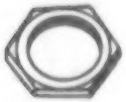
Flanged



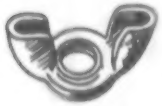
Lock



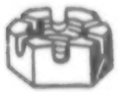
Panel



Wing

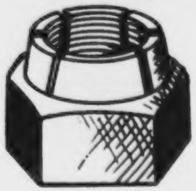


Slotted

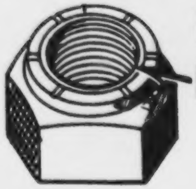


Special Purpose Nuts

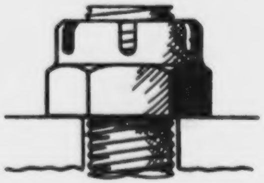
Prevailing Torque
Lock Nut



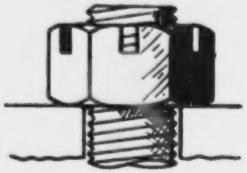
Plastic Insert
Lock Nut



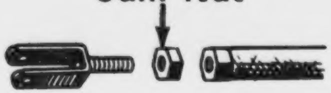
Castle Nut



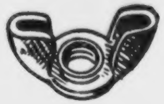
Slotted Nut



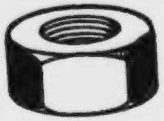
Jam Nut



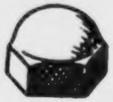
Wing Nut



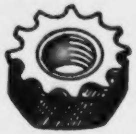
Chamfered Nut
(Both Sides)



Cap Nut

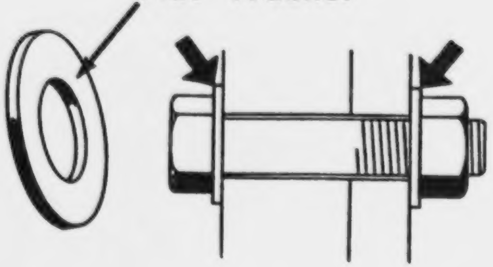


Flange-Lock Nut

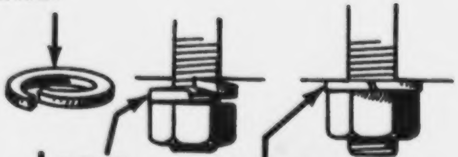


Types of Washers

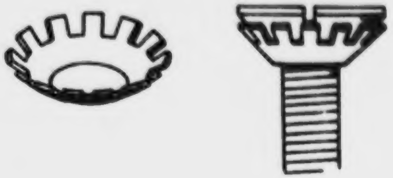
Flat Washer



Lock Washer

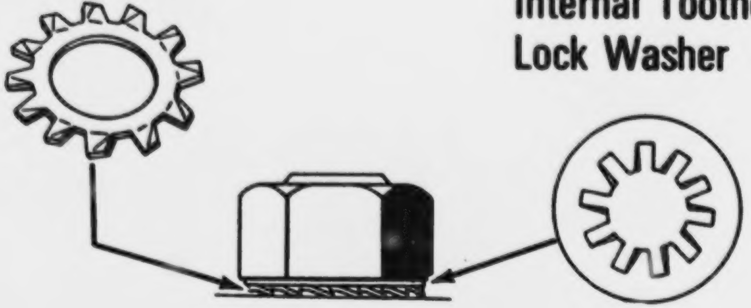

Loose
Tight
(Washer Grips)

Countersunk External Toothed Washer

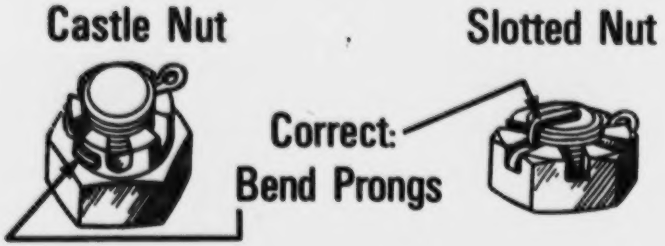


External Toothed Lock Washer

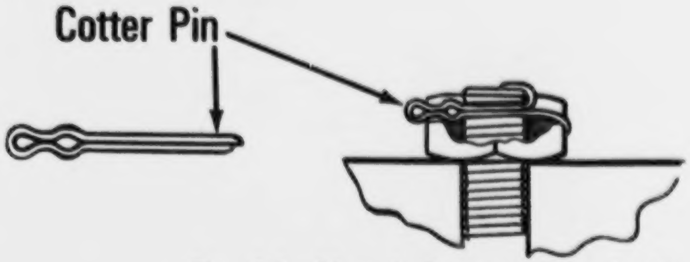
Internal Toothed Lock Washer



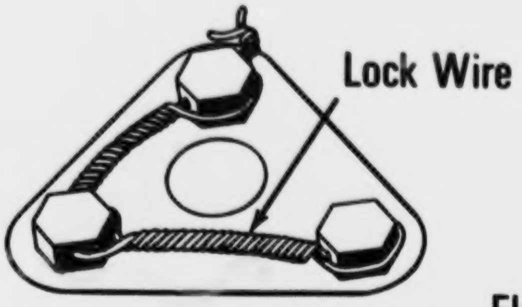
Devices for Locking Nuts or Bolts

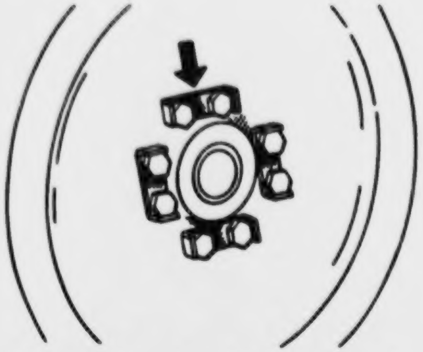

Castle Nut
Slotted Nut
Correct:
Bend Prongs

Cotter Pin Prongs Properly Bent Around
Castle Nut and a Slotted Nut



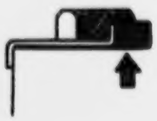
Double-Head Cotter Pin in Use

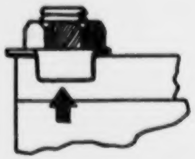




Flat Metal Locks Hold Flywheel
Bolts in Place

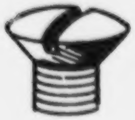
Lock Ears
Properly Bent
Into Place



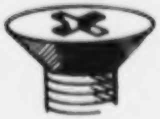


Screw Head Designs

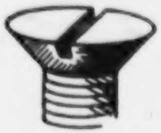
Oval



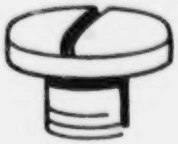
Cross Recessed
or Phillips



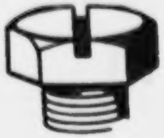
Flat



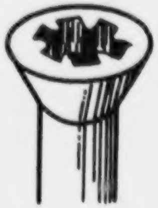
Pan



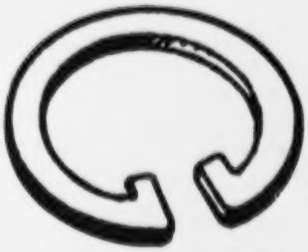
Hex Slotted



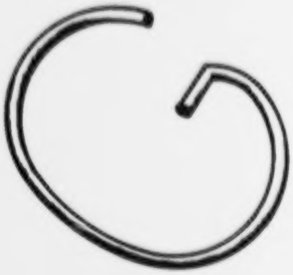
Torx



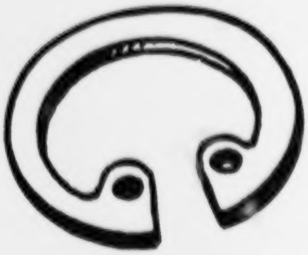
Types of Snap Rings



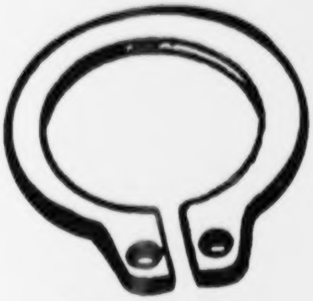
Internal Prong



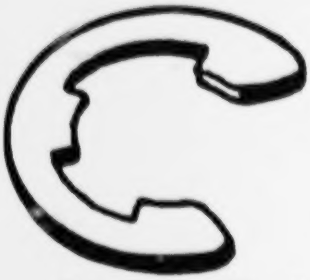
Wire Type



Internal Hole

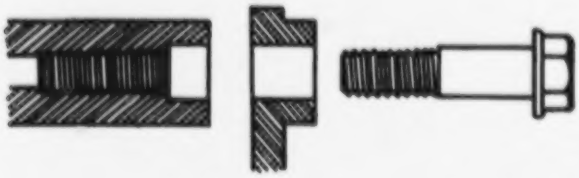


External Hole

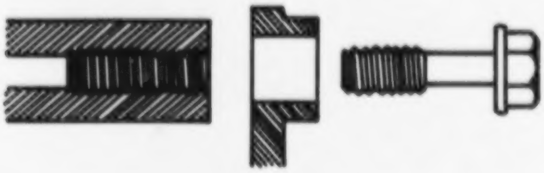


External "E"

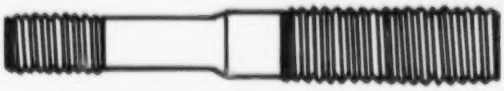
Special Fasteners



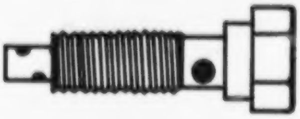
Shoulder Bolt with Cut Threads



Bolt with Rolled-On Threads

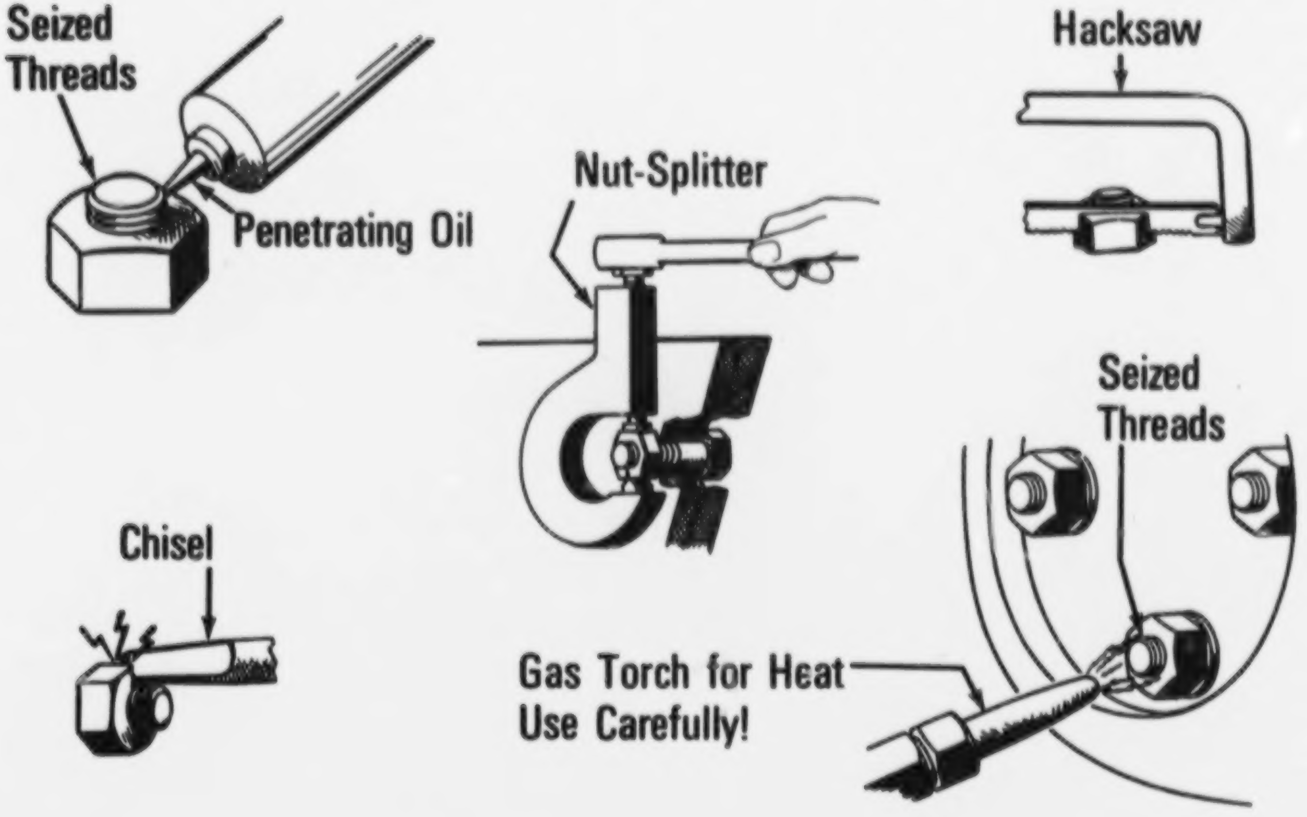


Reduction Stud



Banjo Bolt

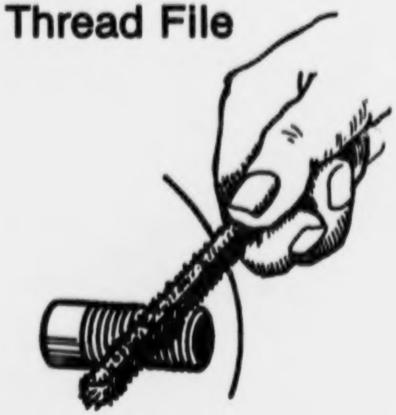
Methods Used to Remove a Seized Nut


Seized Threads
Penetrating Oil
Nut-Splitter
Hacksaw
Chisel
Seized Threads
Gas Torch for Heat
Use Carefully!

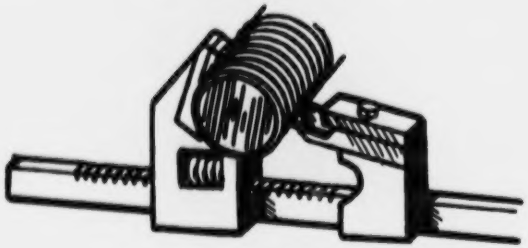
Tools Used to Restore External and Internal Threads

External Threads

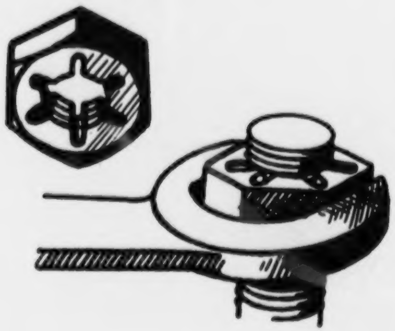
Thread File



Rethreading Tool

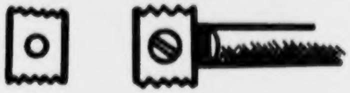


Rethreading Die

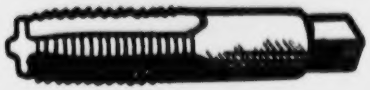


Internal Theads

Internal Thread Chasers



Hand Tap



FASTENERS
UNIT V

ASSIGNMENT SHEET #1 — DRAW THE TIGHTENING SEQUENCE AND LIST TORQUE VALUES FOR A SELECTED COMPONENT FROM A SERVICE MANUAL

Directions: Your instructor will provide you with a service manual and direct you to a part of the manual that outlines procedures for loosening and tightening fasteners. Review the information in the service manual and respond to the following items as directed.

A. Sketch the general shape of the component and the location of all nuts or bolts, and then number the bolts according to the loosening sequence and the tightening sequence.

B. Write the torque values given in the service manual for all nuts and bolts.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

Your Name ______________________ Date ____________

FASTENERS
UNIT V

JOB SHEET #1 — REPAIR DAMAGED THREADS USING A THREAD REPAIR KIT

A. Tools and materials needed

1. Safety glasses
2. Thread repair kit
3. Drill motor

B. Procedure

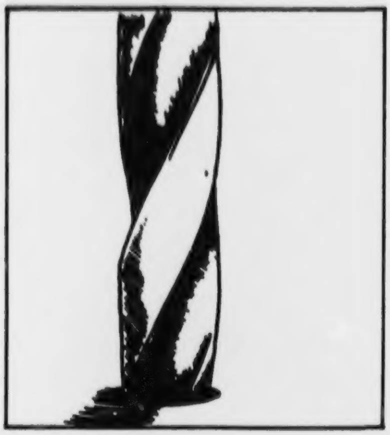
1. Put on safety glasses.
2. Drill out old threads using exact size drill (Figure 1).

   (NOTE: Refer to instructions provided in thread repair kit.)

3. Drill all the way through an open hole or all the way to the bottom of blind hole.

   (NOTE: Make sure hole is straight and that centerline of hole is not moved in drilling process.)

FIGURE 1

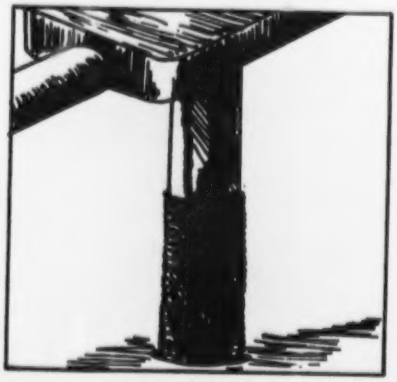


JOB SHEET #1

4. Tap out drilled holes (Figure 2).

   (NOTE: Special drill taps are provided in thread repair kit for threading drilled hole to correct size for outside of thread insert. A standard tap cannot be used.)

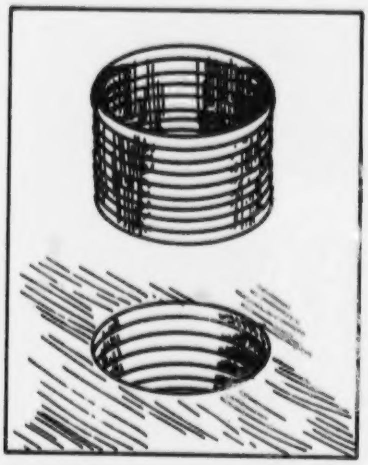
   FIGURE 2



5. Install thread repair insert using appropriate tool (Figure 3).

   (NOTE: Special tools are provided in thread repair kit for installation of thread insert.)

   FIGURE 3



☐ Have instructor inspect work.

5. Clean up area and return tools and materials to proper storage.

FASTENERS
UNIT V

JOB SHEET #2 — REMOVE A BROKEN BOLT USING A SCREW EXTRACTOR SET

A. Tools and materials

1. Basic hand tools
2. Center punch
3. Screw extractor set
4. Drill
5. Clean shop towels
6. Compressed air supply
7. Penetrating oil
8. Safety glasses
9. File

B. Procedure

1. Put on safety glasses.
2. File the broken bolt off flush with the surface or until the broken bolt has a good, flat surface.
3. Place the center punch directly in the center of the broken bolt and tap it lightly with a hammer.
4. Inspect the indentation made by the punch to make sure it is dead center, and then drive the center punch about 2 mm into the bolt.
5. Select the appropriate size drill bit from the chart that comes with extractor set.

   (NOTE: If the drill bit is over 6 mm, pick a smaller drill and drill a pilot hole so drilling be be easier and more accurate.)
6. Have a shopmate help you align the drill so that it is perfectly centered up and down and left and right.
7. Drill a hole all the way through the center of the broken bolt.

JOB SHEET #2

8. Install the screw extractor into the hole that you just drilled.

9. Turn the extractor in the direction that will remove the broken bolt, but be careful not to break the extractor because they are made of metal so strong it is impossible to drill into it.

10. Attempt to remove the bolt, and if it is difficult, heat the surface around the bolt with a torch and try to avoid heating the bolt.

    (NOTE: The idea is to make heat expand the surface around the bolt, but if the bolt itself is heated it will expand too and become even more difficult to remove.)

11. Remove the broken bolt, and allow the component to cool down.

12. Inspect the threads in the component where the bolt was removed.

13. Use a thread repair insert to repair the threads if they are damaged; that procedure is outlined in Job Sheet #1.

☐ Have your instructor check your work.

14. Clean up area and return tools and materials to proper storage.

FASTENERS
UNIT V

PRACTICAL TEST #1
JOB SHEET #1 — REPAIR DAMAGED THREADS USING A THREAD REPAIR KIT

Student's name ______________________________ **Date** ______________

Evaluator's name ______________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:			YES	NO
1.	Selected proper tools.	1.	☐	☐
2.	Selected proper materials.	2.	☐	☐
3.	Wore safety glasses.	3.	☐	☐
4.	Used proper size drill to drill out old threads.	4.	☐	☐
5.	Kept centerline of hole straight.	5.	☐	☐
6.	Tapped out drilled hole.	6.	☐	☐
7.	Installed thread repair insert with proper tool.	7.	☐	☐
8.	Cleaned up area and returned tools and materials to proper storage.	8.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

FASTENERS
. UNIT V

PRACTICAL TEST #2
JOB SHEET #2 — REMOVE A BROKEN BOLT USING A SCREW EXTRACTOR SET

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Selected proper tools.	1.	☐	☐
2. Selected proper materials.	2.	☐	☐
3. Wore safety glasses.	3.	☐	☐
4. Filed off broken bolt flush with surface.	4.	☐	☐
5. Center punched broken bolt properly.	5.	☐	☐
6. Selected proper size drill.	6.	☐	☐
7. Drilled hole straight and all the way through center of bolt.	7.	☐	☐
8. Installed screw extractor properly.	8.	☐	☐
9. Heated surface around bolt, if required.	9.	☐	☐
10. Removed broken bolt.	10.	☐	☐
11. Used thread repair kit to install new threads.	11.	☐	☐
12. Cleaned up area and returned tools and materials to proper storage.	12.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

FASTENERS
UNIT V

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. A metal rod with threads on one end and a head on the other

_____b. A small metal block with a threaded hole in the center for screwing onto a bolt

_____c. A cylindrical piece of metal threaded so it penetrates a material as it is rotated

_____d. A device used to secure or hold things together

_____e. A steel rod with threads on both ends so that one end can be permanently fixed and a nut can be screwed on the other end

_____f. A tool for cutting internal threads

_____g. A tool for cutting external threads

_____h. A fitting that permits variable positioning of a fluid line and permits flow through a partially hollow bolt

_____i. The number of threads per mm on a bolt, nut, or screw

_____j. The capacity of a piece of metal to resist pulling apart

1. Banjo fitting
2. Stud
3. Tensile strength
4. Bolt
5. Die
6. Nut
7. Thread pitch
8. Fastener
9. Screw
10. Tap

2. Complete statements concerning metric bolts and nuts by inserting the word(s) or figure(s) that best completes each statement.

a. Metric bolts are marked by numbers which indicate ____________ and ____________ strength.

b. The ____________ the number the stronger the bolt.

c. The most common replacement bolt for motorcycles and ATV's is grade ____________ which is strong enough for almost all bolt requirements except special applications.

TEST

d. Special metric bolts do not have grade markings, but they do have ____________ numbers.

e. Metric bolts and nuts should always be ____________ according to their diameter, pitch, and grade or to specifications outlined in service manuals.

3. Solve the following problems concerning measuring metric bolts and threads.

a. You need to know the size of a bolt; how would you determine the size?

Answer ____

____

b. Two of your friends are arguing about how to measure the length of a bolt and the first friend says to measure from the bottom of the head to the end of the threads, and friend number two says to measure from the top of the head to the end of the threads; which friend is correct?

Answer ____

____

4. Complete a list of qualities of satisfactory fasteners by circling the word(s) that best completes each statement.

a. (Strong) (tough)

b. (Reusable) (disposable)

c. Easy (to remove) (to install)

d. Withstand (vibration) (repeated striking)

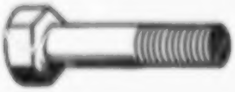
e. (Long lasting) (guaranteed forever)

f. Corrosion (resistant) (proof)

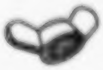
g. Temperature (resistant) (proof)

TEST

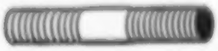
5. Identify typical fasteners.



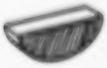
a. ______________________



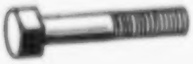
b. ______________________



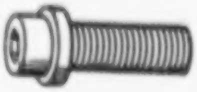
c. ______________________



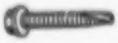
d. ______________________



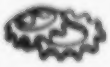
e. ______________________



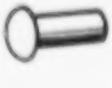
f. ______________________



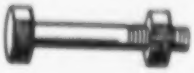
g. ______________________



h. ______________________

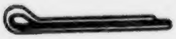


i. ______________________

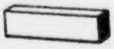


j. ______________________

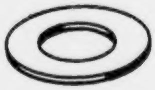
TEST



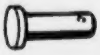
k. ____________________



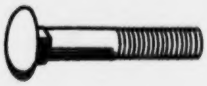
l. ____________________



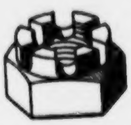
m. ____________________



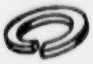
n. ____________________



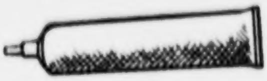
o. ____________________



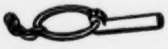
p. ____________________



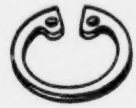
q. ____________________



r. ____________________

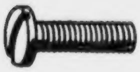


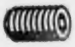
s. ____________________



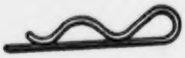
t. ____________________

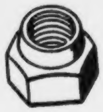
TEST





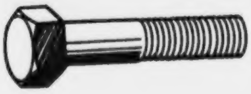
u. ______________________ v. ______________________

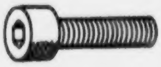




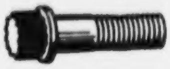
w. ______________________ x. ______________________

6. Identify typical bolt head styles.





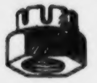
a. ______________________ b. ______________________



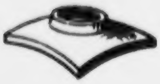
c. ______________________

TEST

7. Identify typical nuts.



a. ______________________________



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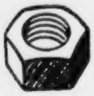

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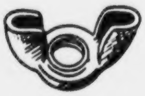

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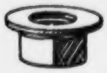

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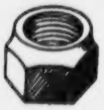

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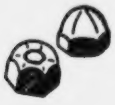

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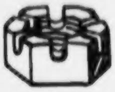

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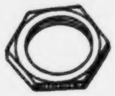
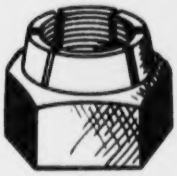


i. ______________________________

TEST

8. Identify special purpose nuts with locking or self-locking features.



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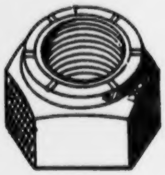

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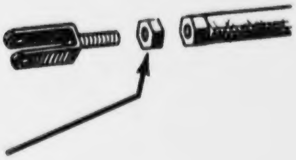

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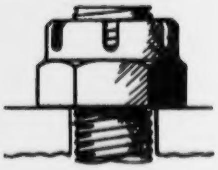

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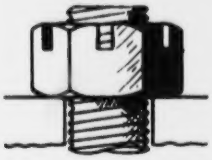

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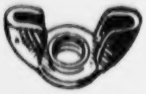

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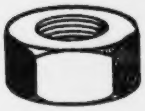

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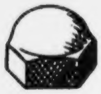

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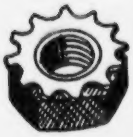
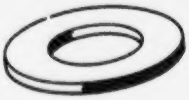
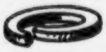
TEST



i. ______________________________

9. Identify five types of washer.





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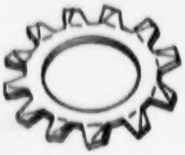

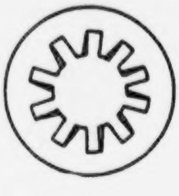

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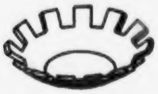
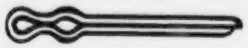
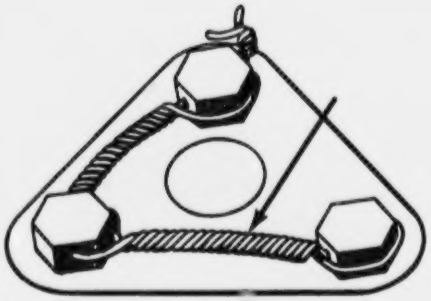


e. ______________________________

TEST

10. Identify devices for locking nuts or bolts.





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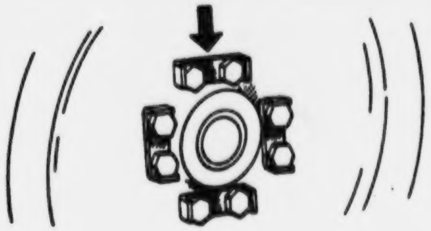
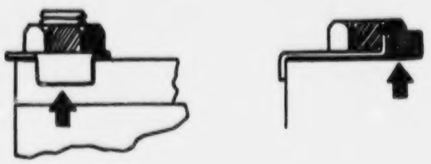
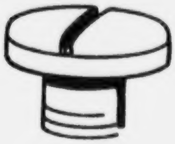
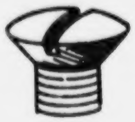




c. ______________________ d. ______________________

11. Identify types of screw head designs.





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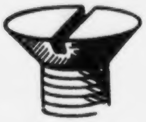
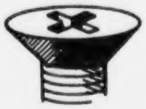
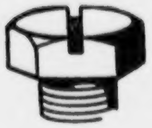




c. ______________________ d. ______________________

TEST



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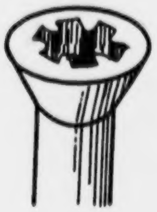
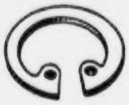
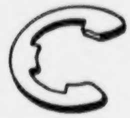


f. ______________________________

12. Identify types of snap rings.



a. ______________________________



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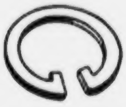

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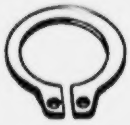


d. ______________________________

13. Complete statements concerning special fasteners by inserting the word(s) that best completes each statement.

    a. Shouldered bolts are used to provide a ____________ distance between two parts to provide a pivot point or to prevent overtightening.

TEST

b. Reduction studs have threads of different sizes on each end and are used to provide additional strength by using a larger diameter thread when a stud is screwed into ____________ or when there is limited depth in the component.

c. Chrome-headed or chrome-plated bolts are used to enhance the ____________ of the vehicle.

d. Many fasteners use a rolled-on thread rather than a cut thread to provide clearance around bolts and studs for ____________ passages.

e. ____________ oil fittings use a bolt that has a hole drilled part way through the bolt from the threaded end, and another hole drilled into the side of the bolt so oil can pass through.

f. Motorcycles and ATV's purposely use ____________ ____________ bolts and fasteners that are designed for specific applications such as extra strength, appearance, capacity to stretch, or unique shape.

g. Special fasteners always have part numbers, and these part numbers should be used to assure that replacement fasteners ____________ the originals.

14. Complete a list of methods used to remove a seized nut by circling the word(s) that best completes each entry.

a. (Penetrating oil) (machine oil)

b. (Hacksaw) (hammer)

c. (Nut splitter) (thread buster kit)

d. (Chisel) (center punch)

e. (Gas torch) (heat pad)

15. Solve problems concerning repairing threads.

a. What kind of thread would you expect to find on a spinning part to prevent it from coming loose?

Answer ____

____

b. Why do some threads have special pitch?

Answer ____

____

TEST

c. What caution would you give to anyone working with threads in an aluminum part?

Answer ____

____

16. Complete statements concerning adhesives and sealers by inserting the word(s) that best completes each statement.

a. Adhesives and sealers are almost never required with gaskets because gaskets that need to be sealed come with ____________ already applied.

b. Nonhardening sealers are sometimes used on oil and crankcase seals to make installation easier and to insure a ____________ seal.

c. Center case joints that do not use ____________ are always sealed with a heat-resistant, nonhardening sealer such as Yamabond, Kawasaki Seal, Suzuki Seal, or Honda Seal.

d. Some bolts require a ____________ adhesive to prevent them from loosening under extreme pressure, excessive heat, or to prevent oil leaks.

17. Solve problems concerning loosening and tightening fasteners.

a. Why should bolts and nuts that secure cylinder heads and engine cases be loosened and tightened in sequence.

Answer ____

____

b. What is the danger in removing a cylinder head when it is hot?

Answer ____

____

c. What is the rule for loosening or tightening a component that is secured with different size fasteners?

Answer ____

____

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

18. Draw the tightening sequence and list torque values for a selected component from a service manual. (Assignment Sheet #1)

19. Demonstrate the ability to:

    a. Repair damaged threads using a thread repair kit. (Job Sheet #1)

    b. Remove a broken bolt using a screw extractor set. (Job Sheet #2)

FASTENERS
UNIT V

ANSWERS TO TEST

1. a. 4
   b. 6
   c. 9
   d. 8
   e. 2
   f. 10
   g. 5
   h. 1
   i. 7
   j. 3

2. a. Grade, tensile
   b. Higher
   c. 8.8
   d. Part
   e. Torqued

3. a. Measure the diameter of the threaded end
   b. The first friend

4. a. Strong
   b. Reusable
   c. To remove
   d. Vibration
   e. Long lasting
   f. Resistant
   g. Resistant

5. a. Hex head bolt
   b. Wing nut
   c. Stud
   d. Woodruff key
   e. Cap screw
   f. Socket head bolt
   g. Tapping screw
   h. Tooth lock washer
   i. Rivet
   j. Bolt and nut
   k. Cotter pin
   l. Square key
   m. Flat washer
   n. Clevis pin
   o. Carriage bolt
   p. Castle nut
   q. Lock washer
   r. Adhesive
   s. Lock pin
   t. Snap ring
   u. Machine screw
   v. Set screw
   w. Spring lock pin
   x. Locking nut

6. a. Hex head bolt
   b. Hex socket head bolt
   c. 12-point head bolt

7. a. Castle
   b. Spring
   c. Hex
   d. Wing
   e. Flanged
   f. Lock
   g. Acorn
   h. Slotted
   i. Panel

ANSWERS TO TEST

8. a. Prevailing torque lock nut
   b. Plastic insert lock nut
   c. Jam nut
   d. Castle nut
   e. Slotted nut
   f. Wing nut
   g. Chamfered nut
   h. Cap nut
   i. Flange lock nut

9. a. Flat washer
   b. Lock washer
   c. External toothed lock washer
   d. Internal toothed lock washer
   e. Countersunk external toothed washer

10. a. Cotter pins
    b. Lockwire
    c. Flat metal locks
    d. Lock ears

11. a. Pan
    b. Oval
    c. Flat
    d. Cross recessed or Phillips
    e. Hex slotted
    f. Torx

12. a. Internal hole
    b. External "E"
    c. Internal prong
    d. External hole

13. a. Fixed
    b. Aluminum
    c. Appearance
    d. Oil
    e. Banjo
    f. High-quality
    g. Duplicate

14. a. Penetrating oil
    b. Hacksaw
    c. Nut splitter
    d. Chisel
    e. Gas torch

ANSWERS TO TEST

15. a. A left-handed thread
    b. To provide additional pressure with limited torque
    c. Threads in aluminum parts are easily damaged, so never overtighten bolts in an aluminum part

16. a. Sealer
    b. Positive
    c. Gasket
    d. Locking

17. a. To assure proper distribution of pressure and avoid damage to the component
    b. Heat can warp and ruin the head
    c. Loosen the smallest fasteners first; tighten smallest fasteners last

18. Evaluated to the satisfaction of the instructor

19. Evaluated according to items recorded in Practical Tests #1 and #2.

SERVICE DEPARTMENT OPERATIONS

UNIT VI

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the organization of a service department and list the duties of service managers and service department technicians. The student should also be able to use a flat rate manual and properly fill out a repair order. These competencies will be evidenced by correctly performing the procedures outlined in the assignment sheet and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to service department operations with their correct definitions.
2. Complete statements concerning how a service department is organized.
3. Select true statements concerning service manager duties.
4. Solve problems concerning service department technician duties.
5. Complete statements concerning repair orders.
6. Complete statements concerning service publications.
7. Select true statements concerning guidelines for using a service manual effectively.
8. Solve problems concerning guidelines for using a flat rate manual effectively.
9. Complete statements concerning sources of other service information.
10. Complete statements concerning service department sales.
11. Fill out a repair order properly. (Assignment Sheet #1)

SERVICE DEPARTMENT OPERATIONS
UNIT VI

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the assignment sheet.

G. Use Assignment Sheet #1 to demonstrate to the class how a repair order can be upgraded through customer-oriented service, and note that in the example in the assignment sheet, the sale was upgraded by more than $40.

H. Point out to students that technicians who demonstrate initiative in service selling will be marked for raises in pay and early advancements.

I. Show a service manual and talk about its proper use.

J. Show a flat rate manual and talk about its proper use.

K. Show examples of other service publications and discuss their importance to safety and service with respect to engineering modifications.

L. Use video tapes as appropriate for visual reinforcement of objectives and job sheets. S1613—*Systematic Solutions to Driveability Complaints*; S1607—*Winning Formula-Customer Relations I*; and S1614—*Winning Formula-Customer Relations II* are available at educational rates in ½" VHS or Beta video tapes from:

American Honda Motor Co., Inc.
Motorcycle VoTech
100 West Alondra Blvd.
Gardena, CA 90248-2702

M. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Hires, Bill, Mark Taylor, and Mike Bundy. *Small Engine Repair Two-Stroke and Four-Stroke Cycle.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1985.

C. Johns, Bruce A., and David D. Edmundson. *Motorcycles Fundamentals, Serice, Repair.* South Holland, IL: The Goodheart-Wilcox Co., Inc., 1984.

SERVICE DEPARTMENT OPERATIONS
UNIT VI

INFORMATION SHEET

I. **Terms and definitions**

A. Accessories — Parts or components which can be added to a motorcycle to improve performance, make the bike look better, or improve operator comfort

B. After-market — Products that are manufactured by other than the original manufacturer to be added to production model equipment

C. Microfiche — A sheet of microfilm where large quantities of information are stored in a microcopy that in turn is magnified for reading

D. OEM (original equipment manufacturer) — The original manufacturer of a vehicle or other piece of equipment

II. **How a service department is organized**

A. Since entry-level technicians almost always go to work in the service department, they need to know how a service department is organized.

B. Most service departments are built around a leader who is called a service manager. (Figure 1)

FIGURE 1

C. Larger shops usually have a service writer whose primary responsibility is writing repair orders.

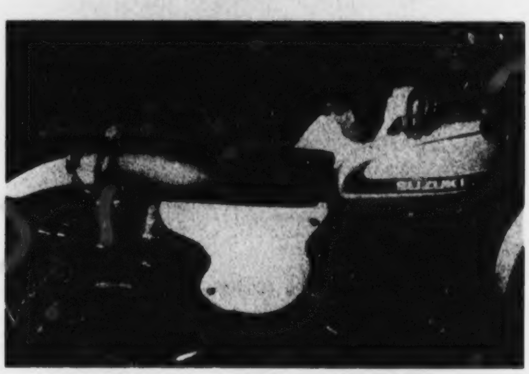
INFORMATION SHEET

D. Other service department members include senior technicians who handle major repairs. (Figure 2)

FIGURE 2

E. Junior technicians handle minor repairs and general service work. (Figure 3)

FIGURE 3



F. Entry-level technicians usually work at tire service, set-up and assembly of new motorcycles, battery service, and maintenance of used units.

G. Some service departments have a specialized technician who does nothing but install accessories.

INFORMATION SHEET

H. Some shops employ an entry-level person for odds and ends of jobs ranging from emptying the trash to sweeping the parking lot. (Figure 4)

(NOTE: These people run errands for others in the shop, and since they frequently "go" for this or "go" for that, they are called, good humoredly, gophers.)

FIGURE 4

III. Service manager duties

A. The service manager has the most important job in a service department and is generally responsible for scheduling all service work and coordinating service activities with sales, management, and bookkeeping.

B. The service manager spends a great deal of time on the phone, and most repair estimates and scheduling of repair service is handled over the phone.

(NOTE: The service manager must have articulate phone skills because people have all kinds of problems, want all kinds of advice, and some people think that a motorcycle can be repaired over the phone.)

C. Scheduling is another important job for a service manager because it requires the ability to estimate how long different kinds of repairs will take.

(NOTE: If you underschedule service work, technicians wind up wasting time, and if service work is overscheduled, the shop gets behind and customers become irritated.)

D. The service manager is responsible for hiring and training technicians, and the general management of people in the department.

E. The service manager must have experience in all aspects of service work because managers have to help technicians with heavy lifting and sometimes give technical advice.

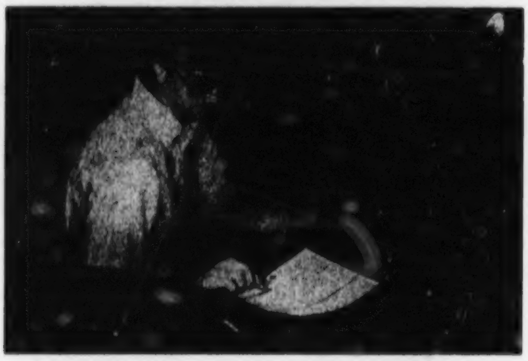
INFORMATION SHEET

IV. **Service department technician duties**

A. Senior technicians are the most valuable to a department because they are able to perform any kind of service work the shop requires.

B. Senior technicians perform engine overhauls, troubleshoot major electrical problems, and do the fine tuning and other jobs that require years of experience. (Figure 5)

FIGURE 5



C. Junior technicians solve minor electrical problems, perform tune-ups, perform engine work that does not require engine removal, and may overhaul smaller-displacement engines.

D. Although entry-level technicians work in tire service and set-up and assembly, they must also take care of used motorcycles and other used vehicles that are for sale.

E. Maintaining used units means running them everyday to make sure they will start, keeping them clean so they'll look good on display and be in a saleable condition. (Figure 6)

FIGURE 6

INFORMATION SHEET

F. Trade-ins that require a tune-up, tire service, or other minor repairs are usually the responsibility of the entry-level technician.

G. During the peak season, busy shops employ gophers for odds and ends and to help everybody, and it is the time of year when the part-time and entry-level people need to be their sharpest so senior technicians will not have to work on minor repairs.

H. In small service departments, one or two technicians may have to wear many hats and be able to perform a wide range of duties.

V. **Repair orders** (Transparency 1)

A. Repair orders are the most important item of paperwork in a service department.

B. Although service managers or service writers usually fill out repair orders, someone else has to do the job when they're gone, and entry-level technicians must know how to read and fill out a repair order.

C. There are three important things to remember about a repair order:

1. It must be neat because someone else will probably have to read the order.

2. It must be complete or it could cause delays.

   Example: If the repair order doesn't list a telephone number where the customer can be reached during the day, someone will have to stay after work to call the customer at home if the problem demands more customer information (and many of them do)

3. It must be specific in order to avoid confusion.

   Example: If the repair order says to repair the tire, the technician who receives the order will wonder whether it means the front tire or the rear tire.

D. A repair order must have complete unit identification because the ID number contains information about color, specific model, and other information significant to ordering the correct replacement parts.

E. A repair order requires a complete listing of parts used, services performed, hours and minutes spent on repair, and the name of the technician who made the repairs.

F. If the work order repairs produce evidence that the customer has overlooked other repairs vital to the safe operation of the unit, the work order should note those needed repairs so the customer will be alerted to the problem.

INFORMATION SHEET

VI. Service publications

A. Service publications in general cover a wide range of literature that is required in a well organized service department.

B. Service manuals are extremely vital because they contain specific service and repair procedures for specific models of motorcycles and other equipment. (Figure 7)

FIGURE 7

C. Service tool catalogs contain ordering information and tool usage instructions for special tools required for working on different manufacturers' lines.

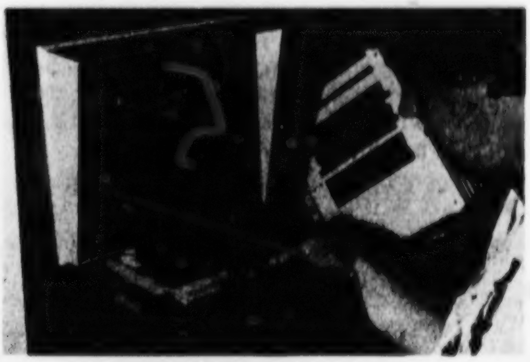
D. Service bulletins contain critical information that may update a service requirement or outline an engineering modification required to improve safety or performance.

Example: A few years ago, a major manufacturer had a problem with an improperly routed battery vent tube. Acid was leaking into the drive chain and creating several other problems: the chain was failing prematurely, breaking and balling up on the countershaft sprocket, and hitting and extensively damaging the engine. The problem was corrected in a technical bulletin sent to all dealers as soon as the problem was identified.

INFORMATION SHEET

E. A microfiche card contains all the parts and part numbers for a given make and model motorcycle. (Figure 8)

FIGURE 8



F. Some microfiche cards contain technical specifications and still others contain specific model year identification to avoid errors in parts orders.

G. Microfiche cards are excellent sources for exploded views of component parts and other graphic materials to make parts location easier.

H. Parts manuals are still available for some machines, but most of the information in parts manuals has been transferred to microfiche and is no longer available in printed form.

I. Information about warranties is sometimes included in service literature, and is frequently information critical to repair policies.

(NOTE: Since certain warranty work is paid by the manufacturer, it is wise for a technician to ask the service manager when there is any problem with warranty work.)

J. Flat rate manuals are available for almost every model of motorcycle and the manuals are vital for charging the customer a fair price for services rendered. (Transparency 2)

K. The flat rate manual is also a valuable guide to let a technician know how much time should be spent on a specific job.

VII. **Guidelines for using a service manual effectively**

A. Make sure you have the appropriate service manual for the model motorcycle you will be working on.

B. Almost all service manuals have an introductory page dedicated to instructions for using the manual, and it's a good idea to read those instructions so you'll know everything the manual contains.

INFORMATION SHEET

C. Service manuals are set up in sections that deal with the entire motorcycle and other sections that deal with specific systems or components.

D. Most sections start with an assembly or system illustration, general instructions, specifications, torque values, special tools, and troubleshooting procedures.

E. After introductory materials, sections usually have a step-by-step procedure and recommended ways to get things done.

VIII. **Guidelines for using a flat rate manual effectively**

A. The flat rate manual is used to calculate labor charges for warranty work for which the dealership will be reimbursed by the manufacturer.

B. The times stated in the flat rate manual are based on the average time a technician with average skills should take to accomplish the job.

C. The times established in the flat rate manual are usually more than an adequate amount of time for completing the job at a normal pace that will permit quality repairs.

D. Units of time used in a flat rate manual are hours and tenths of hours.

Examples: 0.1 = 6 min, 0.5 = 30 min, and 1.0 = 1 hour

E. Abbreviations used in the flat rate manual are usually explained in a legend which appears in the introductory materials.

Examples: EX = Exchange, R&R = Remove and Replace, and slash (/) mark means and/or as in rear wheel bearings/seals EX.

F. Since it is sometimes necessary to remove the crankshaft when exchanging crankcases, there is one job code to cover both procedures.

G. If the repair consists of unrelated procedures, use the code necessary to cover each of the repairs.

Example: Intake manifold EX is 0.6 hours, and muffler EX is 0.2 hours, so the two performed together would be 0.8 hours or 48 min.

IX. **Sources of other service information**

A. The major motorcycle manufacturers are the best sources of service information, and some manufacturers have service hot lines for emergency technical information.

(NOTE: An emergency in this instance means a problem that no one in the service department can solve in a timely manner.)

INFORMATION SHEET

B. Manufacturers who provide items such as tires, tubes, and other accessories also have service hot lines for technical information about their specific products.

C. Accessory and after-market parts manufacturers sometimes have to be contacted when warranty policies are in doubt.

Example: If a tire goes bad prematurely, who should replace it, the OEM or the tire manufacturer?

D. Dealerships who have product lines in common exchange a great deal of service information and are excellent sources for solving problems the manufacturers have not yet confronted.

E. Experienced technicians are great problem solvers and usually good enough at troubleshooting that they can provide invaluable assistance.

X. **Service department sales**

A. Service department sales mostly concern products or services that promote customer safety or vehicle performance.

B. Some repairs lead to discovery of previously unidentified problems, and if the problems affect customer safety, the technician should point the problem out to the service manager.

C. Customers frequently look to repair technicians for recommendations about parts that need to be replaced, services that need to be performed, or accessories that can be added to improve performance or enhance operator comfort.

Example: If a customer came in for a tune-up, but mentioned plans for a long trip, it would be a good time to suggest a complete check of tires, chain, all running gear, safety inspection sticker, tag, lights, and all safety equipment; it would even be appropriate to suggest the customer would be much more comfortable on a long trip if the motorcycle had a fairing

D. A good technician should develop the habit of looking a unit over for problems that could develop in the near future.

Example: If a customer brings a unit in for a tune-up, starts to drive it home and the chain breaks, the customer will be upset that someone failed to notice an obvious replacement need.

E. Never hesitate to recommend parts or services needed, and never feel that dependable services are overpriced because customers do not argue about price when they receive quality service.

Repair Order

CUSTOMER NAME	DATE IN
ADDRESS	DATE PROMISED
CITY STATE ZIP	PHONE

CUSTOMER ACKNOWLEDGES RECEIPT OF A COPY HEREOF

SIGN X ____________________

REPAIR ORDER INSTRUCTIONS

SAFETY CHECK

ORIGINAL ESTIMATE	REVISED ESTIMATE	CONTACTED VIA	TOTAL LABOR
$	$	PHONE ☐ IN PERSON ☐	

MAKE	TAG #
MODEL NO	
SERIAL NO	
MILEAGE	
ORDER Nº 2538	

ORDER	QTY.	PART NUMBER	DESCRIPTION	AMOUNT	ORDER	QTY.	PART NUMBER	DESCRIPTION	AMOUNT

K & N MOTORCYCLES
6105 New Sapulpa Rd.
TULSA, OKLAHOMA 74131
(918) 446-6657
WE SERVICE WHAT EVERYBODY SELLS!

SIGN X ____________________
THANK YOU FOR THIS OPPORTUNITY
TO SERVE YOU

WE RECOMMEND THE FOLLOWING REPAIRS

SUBLET REPAIR — CUSTOMER INITIALS

TOTAL PARTS	
GAS OIL	
TAX	
SUBLET	
TOTAL	

TM 1

MM-251

Flat Rate Manual

XT125

JOB CODE	DESCRIPTION	TIME
	SECTION 1 CYLINDER HEAD, VALVE TRAIN	
1000	Head gasket only ex.	1.1
1002	Valve/spring/seal ex. (ea.)	0.3
1004	Valve guide ex. (ea.)	0.5
1100	Cylinder head complete ex.	2.0
1200	Rocker arm/shaft ex. (both)	0.9
1202	Valve tappet screw ex. (ea.)	0.2
1204	Valve tappet cover(s) ex.	0.1
1240	Cam sprocket cover ex.	0.1
1400	Camshaft/sprocket/bearings ex.	0.6
1410	Cam chain ex.	1.2
1412	Cam chain guide 1 ex. (exhaust)	1.1
1414	Cam chain guide 2 ex.	2.0
1420	Cam chain tensioner assy. ex.	0.1
	SECTION 2 CYLINDER, PISTON, RINGS	
1500	Cylinder/base gasket ex. (incl. hone)	1.3
1510	Piston/rings ex.	0.3
1520	Bore cylinder	1.0
1530	Cylinder studs ex.	0.4
	SECTION 3 CRANKSHAFT, CRANKCASE, COVERS	
2000	Crankshaft/R.H. main bearing ex.	5.4
2002	Crankshaft rebuild	1.0
2100	Crank balancer weight ex.	5.4
2102	Balancer weight bearings ex.	0.2
2110	Balancer gear(s) ex.	1.0
2200	Crankcase assy ex.	6.4
2212	Clutch cover ex.	0.3
2220	Magneto cover ex.	0.2
2224	Countershaft sprocket cover ex.	0.1
	SECTION 4 LUBRICATION SYSTEM	
2300	Oil pump assy/gear ex.	1.0
2310	Oil strainer, plug ex./clean	0.1
2312	Oil filter/cover ex.	0.2
	SECTION 5 PRIMARY DRIVE, CLUTCH	
2500	Primary drive gear ex.	0.8
2600	Clutch assy ex.	0.8
2602	Clutch plates/push rod ex.	0.7
2612	Clutch actuator assy ex.	0.3
	SECTION 6 STARTER SYSTEM	
2750	Kick axle oil seal ex.	0.4
2752	Kick axle/gear assy ex.	0.7
2754	Kick idler gear ex.	0.2

JOB CODE	DESCRIPTION	TIME
	SECTION 7 TRANSMISSION	
2800	Shift shaft/lever assy/oil seal ex.	1.0
2810	Shift pedal ex.	0.1
2900	Transmission rebuild (gears, shaft, cam, forks, bearings)	6.5
2902	Countershaft oil seal ex.	0.7
	SECTION 8 FUEL SYSTEM	
3000	Fuel tank ex.	0.3
3002	Petcock ex.	0.2
3012	Fuel tank emblems ex. (ea.)	0.3
3020	Gas cap ex.	0.1
3100	Carburetor ex.	0.5
3104	Carb rebuild complete	0.4
3108	Adjust fuel lever/float ex.	0.1
3110	Carburetor slide ex.	0.1
3120	Intake manifold ex.	0.4
3130	Canister ex.	0.2(1)
3132	Canister hoses ex.	0.2(1)
3134	Roll-over valve ex.	0.3(1)
	SECTION 9 INTAKE, EXHAUST SYSTEMS	
3200	Air cleaner element/cap ex.	0.2
3202	Air cleaner case ex.	0.5
3204	Air cleaner joint ex.	0.6
3206	Duct ex.	0.3
3208	Covers, air cleaner case ex.	0.1
3600	Exhaust header pipe ex.	0.3
3602	Exhaust muffler ex.	0.2
3800	Muffler protector ex.	0.1
	SECTION 10 CHASSIS	
5000	Frame complete ex.	7.3
5002	Engine stay, front ex.	0.2
5006	Engine stay, upper ex.	0.2
5020	Engine protector ex.	0.1
5100	Rear arm/bearings/seals ex.	0.8
5102	Rear arm pivot shaft ex.	0.1
5200	Rear fender ex.	0.3
5210	Front fender ex.	0.2
5300	Seat ex.	0.1
5302	Seat cover ex.	1.0
5314	Seat lock ex.	0.1
5400	Front footrest assy ex. (ea.)	0.2
5402	Footrest ex. (ea.)	0.1
5500	Side cover(s) ex.	0.1
5600	Sidestand ex.	0.2

Courtesy Yamaha Motor Corporation, U.S.A.

SERVICE DEPARTMENT OPERATIONS
UNIT VI

ASSIGNMENT SHEET #1 — FILL OUT A REPAIR ORDER PROPERLY

Directions: Use the following information to properly fill out the repair order that accompanies this assignment sheet.

A. The customer's name is Bob Smith who lives at 123 Oak Street in Ada, OK 74020, and his business phone number is area code 405-377-2000.

B. The motorcycle was brought in on 7/16/88 and Bob was promised the bike would be ready the following day, 7/17/88.

C. It was a Honda motorcycle with license tag #MC-14, and the model # was CB-125-S Red.

D. The serial # of the motorcycle is CB-125-S-9164807, and it has 13,481 miles on the odometer.

E. Bob's complaint is that the engine will not idle, and the bike is hard to start.

F. Your professional recommendation is that a tune-up will solve Bob's problems, and it will cost approximately $50.

G. Parts and supplies required were: one spark plug at $2.00, and one quart of oil at $2.50.

H. Labor for the tune-up was one hour at $35.00 per hour.

I. While performing the tune up, you noticed that some other repairs vital to safety and performance needed to be made:

   1. Safety inspection sticker had expired and a new inspection sticker would cost $5.00.
   2. The tail light didn't work, and bulb replacement would cost $2.50.
   3. The rear tire could last longer, but really needs to be replaced at a cost of $42.50.

J. Bob has authorized only $50.00 for repairs, and repairs to this point have amounted to $39.50. On the Repair Order Addition that follows the repair order in this assignment sheet, write down what you think would be the best course of action.

ASSIGNMENT SHEET #1

CUSTOMER NAME	DATE IN
ADDRESS	DATE PROMISED
CITY STATE ZIP	PHONE

I hereby authorize the repair work to be done along with the necessary material and hereby grant your employees permission to operate the vehicle herein described on streets, highways or elsewhere for the purpose of testing and/or inspection.

CUSTOMER ACKNOWLEDGES RECEIPT OF A COPY HEREOF

You may exceed your preliminary est. by $__________ without contacting me further. (If no overage is authorized write in "none".)

SIGN X ____________________

REPAIR ORDER INSTRUCTIONS

SAFETY CHECK

ORIGINAL ESTIMATE	REVISED ESTIMATE	CONTACTED VIA	TOTAL LABOR
$	$	PHONE ☐ IN PERSON ☐	

MAKE	TAG #
MODEL NO.	
SERIAL NO.	
MILEAGE	

ORDER Nº – 2538

ORDER	QTY.	PART NUMBER	DESCRIPTION	AMOUNT

ORDER	QTY.	PART NUMBER	DESCRIPTION	AMOUNT

K & N MOTORCYCLES
6105 New Sapulpa Rd.
TULSA, OKLAHOMA 74131
(918) 446-6657
WE SERVICE WHAT EVERYBODY SELLS!

SIGN X ____________________

THANK YOU FOR THIS OPPORTUNITY
TO SERVE YOU

WE RECOMMEND THE FOLLOWING REPAIRS

SUBLET REPAIR — CUSTOMER INITIALS

TOTAL PARTS	
GAS OIL	
TAX	
SUBLET	
TOTAL	

ASSIGNMENT SHEET #1

Repair Order Addition

My recommendations about the additional repairs needed on Bob Smith's motorcycle.

____

____

____

Your name __________________________ Date __________

SERVICE DEPARTMENT OPERATIONS
UNIT VI

ANSWERS TO ASSIGNMENT SHEET

CUSTOMER NAME BoB SMITH	DATE IN 7-16-88
ADDRESS 723 OAK STREET	DATE PROMISED 7-17-88
CITY ADA STATE OK ZIP 74020	PHONE 405 377-2000

CUSTOMER ACKNOWLEDGES RECEIPT OF A COPY HEREOF

SIGN X ______

REPAIR ORDER INSTRUCTIONS SAFETY CHECK

Tune-Up

ORIGINAL ESTIMATE	REVISED ESTIMATE	CONTACTED VIA	TOTAL LABOR	
$ 50.00	$	PHONE ☐ IN PERSON ☐		35 00

MAKE HONDA	TAG # MC14
MODEL NO CB-125-SRED	
SERIAL NO CB-125-S-9164807	
MILEAGE 13,481	
ORDER № — 2538	

	QTY	PART NUMBER	DESCRIPTION	AMOUNT
	1		Spark plug	2 00
	1		Qt. Oil	2 50

ORDER	QTY.	PART NUMBER	DESCRIPTION	AMOUNT

WE RECOMMEND THE FOLLOWING REPAIRS

SAFETY INSPECTION	5.00
TAIL LIGHT BULB	2.50
NEW REAR TIRE	47.50

SUBLET REPAIR — CUSTOMER INITIALS

TOTAL PARTS	2 00
GAS OIL	2 50
LABOR	35 00
TAX	
SUBLET	
TOTAL	39 50

K & N MOTORCYCLES
6105 New Sapulpa Rd.
TULSA, OKLAHOMA 74131
(918) 446-6657
WE SERVICE WHAT EVERYBODY SELLS!

SIGN X Your Signature

THANK YOU FOR THIS OPPORTUNITY TO SERVE YOU

ANSWERS TO ASSIGNMENT SHEET
(Repair Order Addition)

The best recommendation for the repair order addition would be to replace the burned out tail light bulb, make the safety inspection, and put a new sticker on the motorcycle. Then, Bob should be called at his business phone and informed you have made additional repairs, but stayed within his $50.00 limit. Then, suggest to Bob that since his rear tire is nearly worn out that it would be an excellent time-saving opportunity to have the tire replaced while the bike is still in the shop. Besides, it is the peak season for motorcycle enjoyment and Bob can look to safe riding for the rest of the summer.

SERVICE DEPARTMENT OPERATIONS
UNIT VI

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

   ______a. Parts or components which can be added to a motorcycle to improve performance, make the bike look better, or improve operator comfort

   ______b. Products that are manufactured by other than the original manufacturer to be added to production model equipment

   ______c. A sheet of microfilm where large quantities of information are stored in a microcopy that in turn is magnified for reading

   ______d. The original manufacturer of a vehicle or other piece of equipment

   1. Microfiche
   2. Accessories
   3. OEM
   4. After-market

2. Complete statements concerning how a service department is organized by inserting the word(s) that best completes each statement.

   a. Since entry-level technicians almost always go to work in the ____________ department, they need to know how a ____________ department is organized.

   b. Most service departments are built around a leader who is called a service ____________.

   c. Larger shops usually have a service ____________ whose primary responsibility is ____________ repair orders.

   d. Other service department members include ____________ technicians who handle major repairs.

   e. ____________ technicians handle minor repairs and general service work.

   f. Entry-level technicians usually work at ____________ service, set-up and assembly of new motorcycles, ____________ service, and maintenance of used units.

   g. Some service departments have a specialized technician who does nothing but install ____________.

   h. Some shops employ an ____________ ____________ person for odds and ends of jobs ranging from emptying the trash to sweeping the parking lot.

TEST

3. Select true statements concerning service manager duties by placing an "X" beside each statement that is true.

_____a. The service manager has a run of the mill job in a service department and is generally responsible for scheduling all service work and coordinating service activities with sales, management, and bookkeeping.

_____b. The service manager spends a great deal of time on the phone, and most repair estimates and scheduling of repair service is handled over the phone.

_____c. Scheduling is another important job for a service manager because it requires the ability to estimate how long different kinds of repairs will take.

_____d. The service manager is responsible for training technicians, but has nothing to do with hiring.

_____e. The service manager must have experience in all aspects of service work because managers have to help technicians with heavy lifting and sometimes give technical advice.

4. Solve problems concerning service department technician duties.

a. A friend of yours who is studying motorcycle repair tells you that his goal is to start to work in a big agency where he can do nothing but major engine overhaul. What might be wrong with your friend's goal?

Answer ____

____

b. Why do part-time and entry-level persons need to be their sharpest during the warm-weather or peak season for motorcycle use?

Answer ____

____

5. Complete statements concerning repair orders by inserting the word(s) that best completes each statement.

a. Repair orders are the most ____________ item of paperwork in a service department.

b. Although service managers or service writers usually fill out repair orders, someone else has to do the job when they're gone, and ____________ ____________ technicians must know how to read and fill out a repair order.

TEST

c. There are three important things to remember about a repair order:

1) It must be ____________ because someone else will probably have to read the order.

2) It must be ____________ or it could cause delays.

3) It must be ____________ in order to avoid confusion.

d. A repair order must have complete unit identification because the ID number contains information about color, specific model, and other information significant to ordering the correct ____________ parts.

e. A repair order requires a complete listing of parts used, services performed, hours and minutes spent on repair, and the ____________ of the ____________ who made the repairs.

f. If the work order repairs produce evidence that the customer has overlooked other repairs vital to the safe operation of the unit, the work order should note those needed repairs so the customer will be ____________ to the problem.

6. Complete statements concerning service publications by inserting the word(s) that best completes each statement.

a. Service publications in general cover a wide range of literature that is ____________ in a well organized service department.

b. Service manuals are extremely vital because they contain ____________ service and repair procedures for ____________ models of motorcycles and other equipment.

c. Service ____________ catalogs contain ordering information and tool usage instructions for special tools required for working on different manufacturers' lines.

d. Service ____________ contain critical information that may update a service requirement or outline an engineering modification required to improve safety or performance.

e. A microfiche card contains all the ____________ and ____________ ____________ for a given make and model motorcycle.

f. Some microfiche cards contain technical specifications and still others contain specific model year identification to avoid ____________ in parts orders.

g. Microfiche cards are excellent sources for ____________ views of component parts and other graphic materials to make parts location easier.

h. Parts manuals are still available for some machines, but most of the information in parts manuals has been transferred to ____________ and is no longer available in printed form.

TEST

i. Information about ____________ is sometimes included in service literature, and is frequently information critical to repair policies.

j. ____________ ____________ manuals are available for almost every model of motorcycle and the manuals are vital for charging the customer a fair price for services rendered.

k. The ____________ ____________ manual is also a valuable guide to let a technician know how much time should be spent on a specific job.

7. Select true statements concerning guidelines for using a service manual effectively by placing an "X" beside each statement that is true.

_____a. Make sure you have the appropriate service manual for the model motorcycle you will be working on.

_____b. Almost all service manuals have an introductory page dedicated to instructions for using the manual, and it's a good idea to read those instructions so you'll know everything the manual contains.

_____c. Service manuals are set up in sections that deal with the entire motorcycle and other sections that deal with specific systems or components.

_____d. Most sections start with an assembly or system illustration, general instructions, specifications, torque values, special tools, and troubleshooting procedures.

_____e. After introductory materials, sections usually have a step-by-step procedure and recommended ways to get things done.

8. Solve problems concerning guidelines for using a flat rate manual effectively.

a. While using a flat rate manual, you come across an abbreviation which you do not understand. Where would you look for information about the abbreviation?

Answer ____

____

b. How would a flat rate manual express the amount of time required to do a job that should take an hour and a half?

Answer ____

____

TEST

9. Complete statements concerning sources of other service information by inserting the word(s) that best completes each statement.

   a. The major motorcycle manufacturers are the best sources of service information, and some manufacturers have service ____________ ____________ for emergency technical information.

   b. Manufacturers who provide items such as tires, tubes, and other ____________ also have service hot lines for technical information about their specific products.

   c. Accessory and after-market parts manufacturers sometimes have to be contacted when ____________ policies are in doubt.

   d. Dealerships who have product lines in common exchange a great deal of service information and are excellent sources for solving problems the manufacturers have ____________ ____________ confronted.

   e. Experienced technicians are great problem solvers and usually good enough at ____________ that they can provide invaluable assistance.

10. Complete statements concerning service department sales by inserting the word(s) that best completes each statement.

   a. Service department sales mostly concern products or services that promote customer ____________ or vehicle performance.

   b. Some repairs lead to discovery of previously unidentified problems, and if the problems affect customer safety, the technician should point the problem out to the ____________ ____________.

   c. Customers frequently look to repair technicians for recommendations about parts that need to replaced, services that need to be performed, or accessories that can be added to improve ____________ or enhance operator comfort.

   d. A good technician should develop the habit of looking a unit over for problems that could develop in the ____________ ____________.

   e. Never hesitate to recommend parts or services needed, and never feel that dependable services are overpriced because customers do not argue about price when they receive ____________ service.

(NOTE: If the following activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

11. Fill out a repair order properly. (Assignment Sheet #1)

SERVICE DEPARTMENT OPERATIONS
UNIT VI

ANSWERS TO TEST

1. a. 2
   b. 4
   c. 1
   d. 3

2. a. Service, service
   b. Manager
   c. Writer, writing
   d. Senior
   e. Junior
   f. Tire, battery
   g. Accessories
   h. Entry-level

3. b, c, e

4. a. Major engine overhaul is almost always performed only by senior technicians who have had years of experience
   b. During the peak season, senior technicians need to be free of the need to work on minor repairs

5. a. Important
   b. Entry-level
   c. 1) Neat
      2) Complete
      3) Specific
   d. Replacement
   e. Name, technician
   f. Alerted

6. a. Required
   b. Specific, specific
   c. Tool
   d. Bulletins
   e. Parts, part numbers
   f. Errors
   g. Exploded
   h. Microfiche
   i. Warranties
   j. Flat rate
   k. Flat rate

7. a, b, c, d, e

ANSWERS TO TEST

8. a. In the introductory materials
   b. 1.5

9. a. Hot lines
   b. Accessories
   c. Warranty
   d. Not yet
   e. Troubleshooting

10. a. Safety
    b. Service manager
    c. Performance
    d. Near future
    e. Quality

11. Evaluated to the satisfaction of the instructor

MOTORCYCLE ENGINES
UNIT VII

UNIT OBJECTIVE

After completion of this unit, the student should be able to list the parts and define the operations of four-stroke and two-stroke motorcycle engines. The student should also be able to discuss causes of poor engine performance, troubleshoot a no-start complaint on a one-cylinder motorcycle engine, and perform a leak-down test on a one-cylinder motorcycle engine. These competencies will be evidenced by correctly completing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to motorcycle engines with their correct definitions.
2. Complete statements concerning basic motorcycle engine theory.
3. Match terms related to piston movement with their meanings.
4. Complete statements concerning two-stroke and four-stroke operations.
5. Match terms concerning major components of a four-stroke engine with their functions.
6. Match terms concerning major components of a two-stroke engine with their functions.
7. Arrange in order the steps in the operation of a four-stroke engine.
8. Arrange in order the steps in the operation of a two-stroke engine.
9. Select true statements concerning four-stroke engine characteristics.
10. Select true statements concerning two-stroke engine characteristics.
11. Complete statements concerning problems that cause poor engine performance.
12. Complete a list of tools required for basic engine troubleshooting.

OBJECTIVE SHEET

13. Demonstrate the ability to:

    a. Troubleshoot a no-start complaint on a one-cylinder motorcycle engine. (Job Sheet #1)

    b. Perform a leak-down test on a one-cylinder motorcycle engine. (Job Sheet #2)

MOTORCYCLE ENGINES
UNIT VII

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Show students as many different types of engines as you have available, and explain the technical features of each engine so students will have a better perspective on overall engine design.

H. Use a cut-away engine or have a factory rep bring a cut-away engine to class so students can see the mechanics of an engine in operation and actually see what happens during intake, compression, power, and exhaust.

I. Invite a factory rep or a dealer to talk to the class about advancements in motorcycle engine technology.

J. Read Job Sheet #1 carefully and disable or bug a motorcycle as required so students will have a legitimate no-start complaint to work with.

(NOTE: Bugging three bikes with a different no-start condition will permit students to work on all three problems — spark, fuel, and compression.)

K. Use video tapes as appropriate for visual reinforcement of objectives and job sheets. S1611—*Two Stroke Theory and Troubleshooting* is available at educational rates in 1/2" VHS or Beta video tape from:

American Honda Motors Co., Inc.
Motorcycle VoTech
100 West Alondra Blvd.
Gardena, CA 90248-2702

L. Other video tapes appropriate for this unit include *Introduction to Internal Combustion Engines, Two-Stroke Theory, Introduction to Four-Stroke Theory,* and *Combustion in Action*. These videos are available in 3/4" U-Matic, 1/2" Beta I, 1/2" Beta II, or 1/2" VHS formats from:

Kawasaki Motors Corp., U.S.A.
Service Training
9950 Jeronimo Road
Irvine, CA 92718-2016

M. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Hires, Bill, Mark Taylor, and Mike Bundy. *Small Engine Repair Two-Stroke and Four-Stroke Cycle.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1985.

C. *Motorcycle Technical Training Centers Technician's Handbook.* Cypress, CA: Yamaha International Corporation, 1979.

D. *Honda Pro Training Reference Materials,* (Engine Service). Gardena, CA 90247: American Honda Motor Co., Inc., 1984.

MOTORCYCLE ENGINES
UNIT VII

INFORMATION SHEET

I. **Terms and definitions**

A. Bore — Diameter of a cylinder

B. Cam ground — A manufacturing process that gives pistons an elliptical shape

C. cc (cubic centimeter) — The measurement of engine displacement on a metric scale

D. Combustion chamber — Area between the top of the piston and the cylinder head where the air/fuel mixture is ignited

E. Crankcase — Housing for the crankshaft, transmission, and related parts

F. Cycle — Completion of the series of events required to produce a power impulse from an engine

G. Horsepower — Measurement of work done in a given period of time

H. PSI (pounds per square inch) — A method of measuring pressure

I. Reciprocating motion — The back and forth or up and down motion made by a piston

J. Torque — The measurement of turning or twisting force

II. **Basic motorcycle engine theory**

A. There are two major types of motorcycle engines:

1. Two-stroke cycle engines
2. Four-stroke cycle engines

B. In the two-stroke cycle engine, the cycle of events that produces power takes two strokes to complete or 360 degrees of crankshaft rotation.

C. In the four-stroke cycle engine, the cycle of events that produces power takes four strokes to complete or 720 degrees of crankshaft rotation.

(NOTE: Two-stroke cycle and four-stroke cycle are technically the correct names for the two types of engines, but in normal reference they are usually called two-stroke or four-stroke engines, and they will be referenced that way throughout the remainder of this unit.)

INFORMATION SHEET

D. Engines are usually designed to meet specific demands, and this requires a variety of engine shapes or configurations.

1. One cylinder
2. In-line twin cylinders
3. V-twin cylinders
4. V-4 cylinders
5. Opposed-twin cylinders
6. Opposed-four cylinders
7. In-line three cylinders
8. In-line four cylinders
9. In-line six cylinders

III. Terms related to piston movement and their meanings

A. TDC (Top Dead Center) — The position of a piston at its highest point in a cylinder

B. ATDC (After Top Dead Center) — The position of a piston at a point between TDC and halfway down the stroke

C. BTDC (Before Top Dead Center) — The position of a piston at a point between halfway up and TDC

D. BDC (Bottom Dead Center) — The position of a piston at its lowest point in the cylinder

E. ABDC (After Bottom Dead Center) — The position of a piston at a point between BDC and halfway up the stroke

F. BBDC (Before Bottom Dead Center) — The position of a piston at a point between halfway down and BDC

IV. Two-stroke and four-stroke operations

A. The whole idea of an internal combustion engine is to create heat energy through combustion of the fuel/air mixture and convert that to mechanical energy through rotation of the crankshaft.

INFORMATION SHEET

B. A four-stroke engine requires four distinct piston strokes to produce one power impulse.

   1. The intake stroke

   2. The compression stroke

   3. The power stroke

   4. The exhaust stroke

C. Essentially, what happens in a four-stroke engine is what happens in a two-stroke engine except that the two-stroke operation is more complex because the two-stroke engine has intake and exhaust ports instead of valves.

D. The four-stroke engine can exhaust burned gases out of the exhaust valve, but the two-stroke engine has to force burned gases out an exhaust port in a unique way that is called "scavenging."

V. **Major components of a four-stroke engine** (Transparency 1)

   A. Crankcase — Contains the crankshaft, bearings, transmission, and other components of the lower engine

   B. Crankshaft — The shaft which changes reciprocating piston motion into rotary motion

   C. Connecting rod — Attaches the piston to the crankshaft

   D. Piston — A cam ground cylinder that slides up and down in an engine cylinder and is attached to a connecting rod

   E. Rings — Metal inserts fitted into the top of a piston to retain pressure as the piston moves

   F. Cylinder — The hollow cylinder extending from the engine case to the cylinder head to house the piston and permit piston movement

   G. Cylinder head — The covering that closes the top end of the cylinder and may contain valves and cam shafts

   H. Valves — Devices used to open and close intake and exhaust passages

   I. Camshafts — Shafts with egg-shaped lobes that strike rocker arms to change rotary motion from the crankshaft into reciprocating motion to open valves

   J. Gasket — Allows for the irregularities in the mating surfaces of two parts to assure a leak-proof seal

INFORMATION SHEET

VI. **Major components of a two-stroke engine** (Transparency 2)

A. Crankcase — Contains the crankshaft, bearings, transmission, and other components of the lower engine

B. Crankshaft — The shaft which changes reciprocating piston motion into rotary motion

C. Connecting rod — Attaches the piston to the crankshaft

D. Piston — A cam-ground cylinder that slides up and down in an engine cylinder and is attached to a connecting rod

E. Rings — Metal inserts fitted into the top of a piston to retain pressure as the piston moves

F. Cylinder — The hollow cylinder extending from the engine case that houses the piston and contains intake, transfer, and exhaust ports

G. Cylinder head — The covering that closes the top end of the cylinder

H. Gasket — Allows for irregularities in the mating surfaces of two parts to assure a leak-proof seal

VII. **Steps in operation of a four-stroke engine** (Transparency 1)

A. The 720 degree revolution of a four-stroke engine begins with the piston at TDC.

B. As the piston moves down to BDC, it creates a partial vacuum in the cylinder as the intake valve opens to allow the air/fuel mixture into the cylinder.

(NOTE: This is called the "intake" stroke.)

C. As the piston moves up from BDC to TDC, both the intake and exhaust valves close and the air/fuel mixture in the cylinder is compressed.

(NOTE: This is called the "compression" stroke.)

D. As the piston reaches TDC, the spark plug ignites the air/fuel mixture and the combustion produces high pressure which forces the piston to move down.

E. The downward movement of the piston is carried through the connecting rod to the crankshaft, and it causes the crankshaft to rotate.

(NOTE: The previous two events are called the "power" stroke.)

INFORMATION SHEET

F. As the piston completes the power stroke, and just before it reaches BDC, the exhaust valve opens and burned gases are forced out of the cylinder as the piston moves on up to TDC.

(NOTE: The final step is called the "exhaust" stroke.)

G. The piston has made four complete strokes, has completed a 720 degree rotation, and is at TDC once more as the cycle starts over.

VIII. **Steps in operation of a two-stroke engine** (Transparency 2)

A. The 360 degree revolution of a two-stroke engine begins with the piston at BDC.

B. As the piston moves upward, it clears the intake port and allows a fresh supply of the air/fuel mixture from the carburetor to enter the crankcase.

C. As the air/fuel mixture enters the crankcase, the piston moves past and closes the exhaust port as it compresses the air/fuel mixture above the piston.

D. As the piston reaches TDC, a spark ignites the compressed fuel/air mixture and drives the piston down with enough force that the power turns the crankshaft.

E. As the piston moves down, it closes the intake port and compresses the air/fuel mixture in the crankcase.

F. As the piston moves farther down it slides past the exhaust port which opens to allow burned gases to flow out of the cylinder.

G. As the piston moves even farther down, it opens the transfer port which allows the air/fuel mixture that has been compressed in the crankcase to enter the upper part of the cylinder.

(NOTE: This is how the air/fuel mixture gets to the upper cylinder combustion chamber so it can be compressed as indicated in Step C.)

H. The fresh air/fuel mixture sweeps into the upper cylinder and quickly pushes out remaining exhaust gases from the cylinder in a scavenging action.

I. Just as the combustion chamber above the piston is filled with a fresh supply of air/fuel, the piston reaches BDC and starts the cycle over again.

INFORMATION SHEET

IX. **Four-stroke engine characteristics**

A. Four-stroke engines are typically found on street bikes and touring bikes because they are durable, reliable, and run more smoothly than two-stroke engines.

(NOTE: There are exceptions to the rule, but in the 50cc to 1400cc range and beyond, street and touring bikes usually have four-stroke engines.)

B. A four-stroke engine properly operated and maintained is virtually trouble free and will not require nearly as much service as a two-stroke engine.

C. Four-stroke engines typically give excellent gas mileage and generally give better performance in a wider power band.

D. Four-stroke engines have lower pollution levels in the exhaust emissions and four-stroke engines do meet EPA standards for exhaust emission control.

E. Four-stroke engines usually run a bit cooler than two-stroke engines.

F. Four-stroke engines are identified by:

1. Number of cylinders and valves per cylinder
2. Cylinder arrangement
3. Number of camshafts
4. Placement of camshafts

Example: A Honda V-65 engine is a V-4 double overhead cam with four valves per cylinder

X. **Two-stroke engine characteristics**

A. Two-stroke engines are typically used on off-road bikes and ATV's because they are lightweight, compact, powerful, and cost less than four-stroke engines.

B. Two-stroke engines have few moving parts and are easy to service, but require service more often.

(NOTE: High rpm and heat build-up contribute to fast piston, ring, and cylinder wear in two-stroke engines.)

INFORMATION SHEET

C. Modern two-stroke engines have several improvements that enhance performance:

   1. They are liquid cooled.

   2. They have smaller bores and longer strokes.

   3. They turn at a slower rpm, yet produce horsepower comparable to older type two-strokes because they produce more torque.

      Example: An older two-stroke might have a 70mm bore, a 64mm stroke, and a 250cc displacement while a modern two-stroke with a 250cc displacement would have a 66 mm bore and a 72 mm stroke

   4. They have hi-tech coatings on cylinder walls and pistons to improve durability.

   5. They have improved exhaust design that increases horsepower and improves performance.

D. Almost all two-stroke engines use a reed valve induction system to control the intake flow of the fuel/air mixture.

E. Some two-stroke engines use some type of valve to control exhaust port timing and improve performance.

F. It's difficult to find a two-stroke engine that meets the exhaust emission control standards set by the EPA.

   (NOTE: This is partly due to the fact that engine lubricating oil is either injected into the engine by an injector pump or premixed with the gas, and oil simply does not burn well.)

XI. Problems that cause poor engine performance

A. To perform well, an engine must have:

   1. Good quality fuel

   2. Good compression

   3. A strong spark

      (NOTE: On a multi-cylinder engine, low compression, lack of fuel, or lack of spark may only cause a miss or a rough-running condition.)

B. Without the proper combination of fuel, compression, and spark, an engine will not run smoothly and may not run at all.

INFORMATION SHEET

C. The purpose of the carburetor is to mix a specified amount of fuel with air to serve engine needs at all speeds.

D. Problems with carburetors can almost always be corrected with a complete disassembly, cleaning, reassembly, and adjustment.

E. Compression is affected by several conditions:

  1. Improper valve adjustment is the most common problem, especially on smaller engines (125cc or less).
  2. Ring and piston wear or damage cause poor compression.
  3. A leaking cylinder head gasket will cause poor compression.
  4. Burned or bent valves cause poor or no compression.

F. The lack of a strong spark may be caused by the malfunction of any part of the ignition system:

  1. Ignition points that are dirty, burned, worn, or improperly adjusted can cause a weak spark or no spark at all.
  2. Defective triggering coils in electronic ignition systems can cause a weak spark or no spark at all.
  3. A weak power source like a battery or primary coil can cause a weak spark or no spark at all.
  4. A defective ignition control unit in an electronic ignition system can cause erratic spark, weak spark, or no spark at all.
  5. Connecting wires that are disconnected, shorted, or damaged usually result in no spark at all.

G. For an engine to run smoothly, fuel, spark, and compression events must happen in a specific sequence and at a specific time.

XII. **Tools required for basic engine troubleshooting**

A. Basic hand tools

B. Clean shop towel

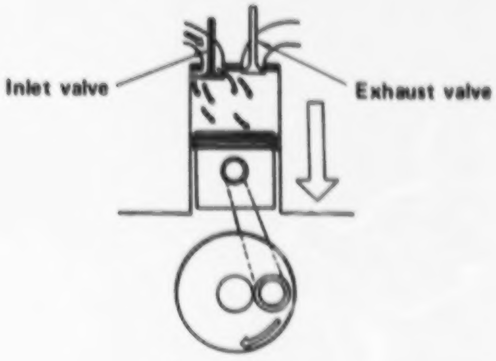
C. One liter container for catching gasoline

D. A pump-type oil can with 30W oil in it

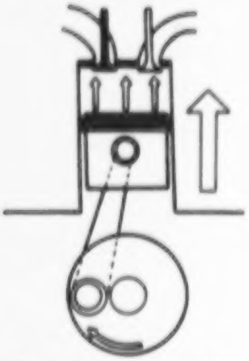
E. A compression gauge set

F. A spark tester

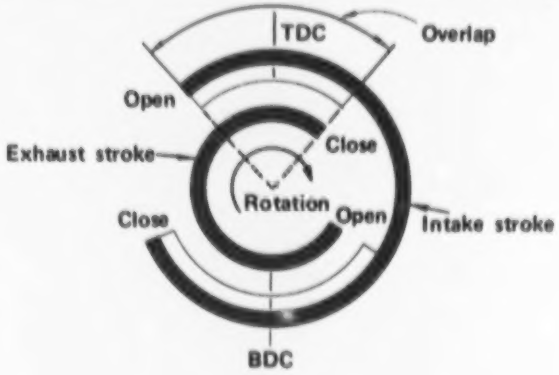
Four-Stroke Engine Operation

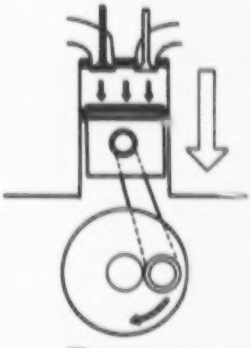

Inlet valve
Exhaust valve

Intake

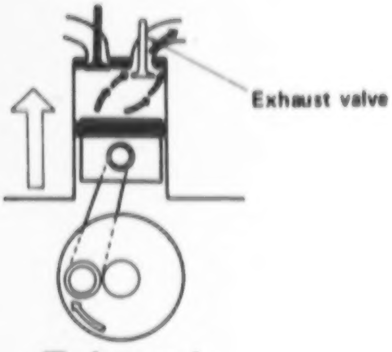


Compression


TDC
Overlap
Open
Exhaust stroke
Close
Rotation
Close
Open
Intake stroke
BDC



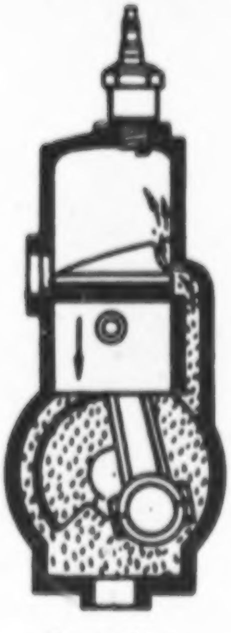
Power


Exhaust valve

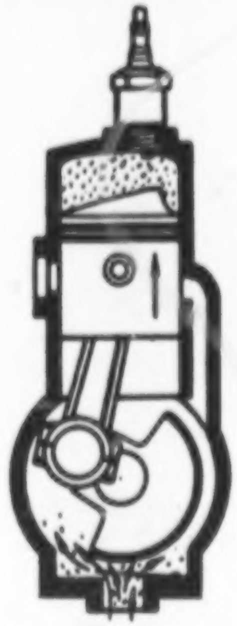
Exhaust

Courtesy Yamaha Motor Corporation, U.S.A.

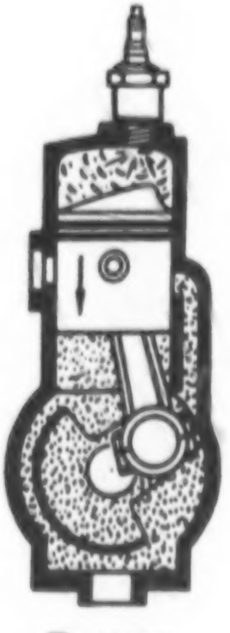
Two-Stroke Engine Operation



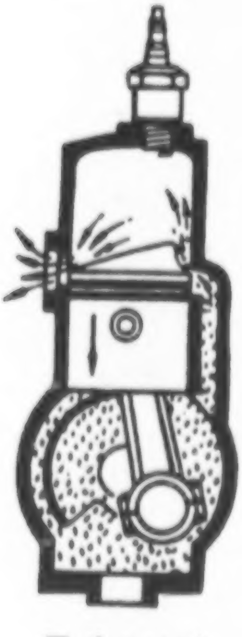
Intake



Compression



Power



Exhaust

MOTORCYCLE ENGINES
UNIT VII

JOB SHEET #1 — TROUBLESHOOT A NO-START COMPLAINT ON A ONE-CYLINDER MOTORCYCLE ENGINE

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towel
5. One liter container to catch gasoline
6. Spark tester
7. Fuel as required
8. Pencil and paper
9. Safety glasses

B. Routine #1 — Checking for proper spark

1. Check the area to make sure it is free of fire hazards and that there is a fire extinguisher nearby.
2. Put on safety glasses.
3. Remove the spark plug. (Figure 1)

FIGURE 1

JOB SHEET #1

4. Clip the spark tester onto a convenient ground on the cylinder. (Figure 2)

FIGURE 2

5. Install the spark plug high tension lead onto the spark tester.

6. Make sure the transmission is in neutral with switch ON and attempt to start the engine.

    a. If there is a spark present, the no-start problem is not likely to be in the ignition system.

    b. If there is no spark present, you have probably isolated the problem.

    (NOTE: Troubleshooting an ignition system will be covered in a later unit, but for now, continue your troubleshooting to familiarize yourself with a systematic no-start troubleshooting sequence.)

☐ Have your instructor check your work.

7. Record your findings on the troubleshooting log that accompanies this job sheet.

C. Routine #2 — Making a dry compression test

1. Leave your safety glasses on.

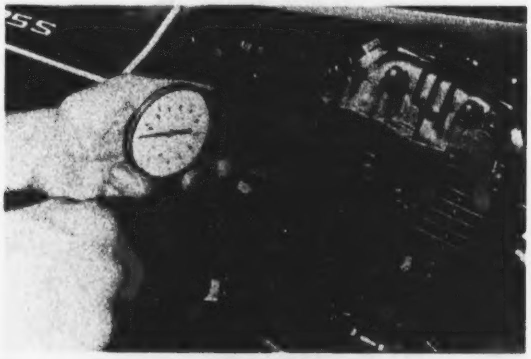
2. Select the proper adapter and screw it into the spark plug hole. (Figure 3)

FIGURE 3

JOB SHEET #1

3. Clip the compression tester to the adapter. (Figure 4)

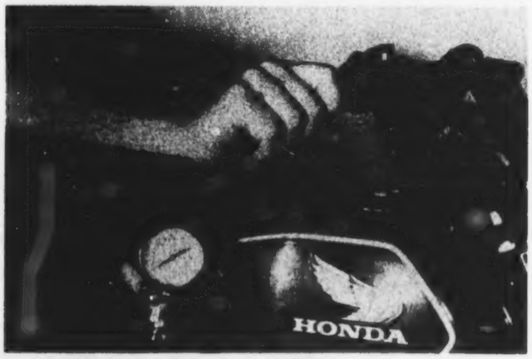
FIGURE 4



4. Lay the compression gauge in a convenient place.

5. Turn the throttle on the motorcycle to a wide open position. (Figure 5)

FIGURE 5



6. Crank the engine until the engine has made several revolutions or until the needle on the gauge stops moving. (Figure 6)

FIGURE 6

JOB SHEET #1

7. Read and record your results on the troubleshooting log.

    a. If compression is low, it could be a problem with the head gasket or problems with the valves or the pistons and rings.

    (NOTE: Top end repairs will be covered in a later unit, but for now, continue your troubleshooting.)

    b. If compression appears to be okay, the problem is somewhere else.

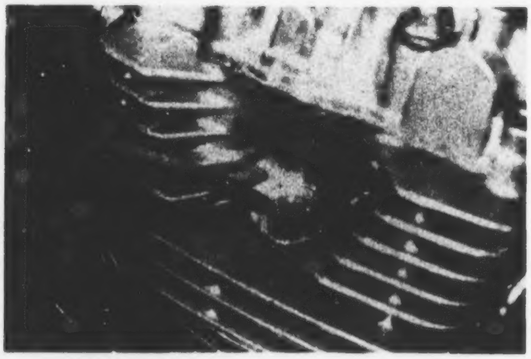
    c. If compression is low, a wet test will help you further isolate the problem.

☐ Have your instructor check your work.

D. Routine #3 — Making a wet compression test

1. Leave your safety glasses on.
2. Remove the compression gauge adapter from the spark plug hole.
3. Squirt a small amount of engine oil out into the spark plug hole. (Figure 7)

FIGURE 7



4. Replace the adapter in the spark plug hole.
5. Repeat the compression checking procedure outlined in Routine #2.

    a. If compression increase is noticeable, the problem is most likely with the piston and rings.

    (NOTE: Piston and ring service will be covered in a later unit.)

    b. If there is little or no increase in compression, the problem is most likely in the valves or possibly the head gasket.

    c. If compression appears to be okay, move on and troubleshoot the fuel system.

JOB SHEET #1

6. Record your results on the troubleshooting log.

☐ Have your instructor check your work.

E. Routine #4 — Checking the fuel system

1. Leave your safety glasses on.

2. Make sure the fuel valve is turned on.

   (NOTE: Some models have a vacuum-controlled fuel valve that has to be switched to a "Prime" position before fuel will go to the carburetor when the engine is not running.)

   a. If the fuel valve was turned off, turn it on and it's possible you have quickly found the problem.

   b. If the fuel valve was on, check to make sure there is adequate fuel in the tank.

   c. If the tank requires fuel, put at least a liter of fuel in it.

3. Try to start the motorcycle to see if filling the tank solved the problem.

   a. If the bike starts, you solved the problem.

   b. If the bike will not start, continue troubleshooting.

4. Loosen the drain screw at the bottom of the fuel bowl.

   a. If fuel is present at this point, the problem is in the carburetor and the carburetor should be removed, cleaned, replaced, and adjusted.

   b. If fuel is not present at this point, the problem is in the fuel delivery system and may require removing the fuel tank or the fuel valve, or both.

      (NOTE: Carburetor service and fuel delivery service will be covered in a later unit.)

5. Record your findings on the troubleshooting log.

6. Make a written appraisal of what you think is causing the no-start condition you have been troubleshooting.

☐ Have your instructor check your work.

7. Clean up area and return tools and materials to proper storage.

JOB SHEET #1

Troubleshooting Log

Routine #1: Checking for proper spark

Spark is not present ☐

Spark is present ☐

Routine #2: Making a dry compression test

Compression reading: ____________________

Routine #3: Making a wet compression test

Compression reading: ____________________

Routine #4: Checking the fuel system

Fuel valve was not turned on ☐

Fuel valve was turned on ☐

Checking for fuel at the drain screw at the bottom of the fuel bowl proved that:

Problem is in the carburetor ☐

Problem is in the fuel delivery system ☐

Your appraisal of what you think is causing the no-start condition:

____

____

Your Name:______________________________ Date:____________

MOTORCYCLE ENGINES
UNIT VII

JOB SHEET #2 — PERFORM A LEAK-DOWN TEST ON A ONE-CYLINDER MOTORCYCLE ENGINE

A. Tools and materials

1. Motorcycle or engine as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towel
5. Cylinder leakage tester
6. Minimum 60-lb. compressed air supply
7. Safety glasses

B. Procedure

1. Check to make sure the area is free of fire hazards and that there is a fire extinguisher nearby.
2. Put on safety glasses.
3. Remove the spark plug.
4. Put the engine at TDC on the compression stroke.

   (NOTE: On a four-stroke engine, make certain it is not on TDC between the exhaust and intake stroke, so if you have doubts, ask your instructor for help.)

JOB SHEET #2

5. Lock the crankshaft in place so that it cannot turn during this test. (Figure 1)

   (CAUTION: Have your instructor check to make sure the crankshaft is secure because if it turns when compressed air is applied to the engine it will invalidate the test and perhaps injure you or somebody else.)

   FIGURE 1

6. Install the adapter into the spark plug hole. (Figure 2)

   FIGURE 2

JOB SHEET #2

7. Hook the leakage tester to the adapter. (Figure 3)

   (CAUTION: If you're using a manually adjustable tester, make certain that the regulator control is backed out all the way so there will be no immediate surge of pressure in the cylinder when you turn the compressed air on.)

FIGURE 3

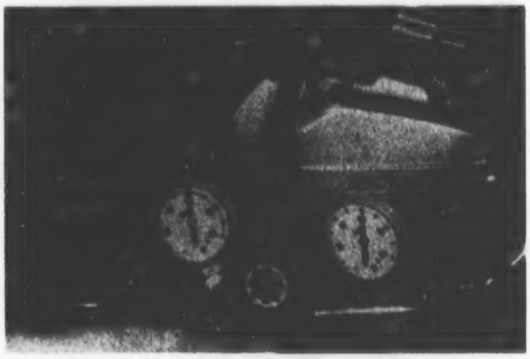
8. Hook the compressed air line onto the tester. (Figure 4)

FIGURE 4

JOB SHEET #2

9. Turn the regulator knob in slowly to permit compressed air to enter the cylinder, and do not open the regulator beyond 60 PSI. (Figure 5)

FIGURE 5



10. Record the pressure readings on both gauges: left gauge ____________; right gauge ____________.

    a. If both gauges read the same, it means there is zero leakage and there is no problem with compression.

    b. If the second gauge reads less than 60 PSI, divide that figure into 60, and then subtract that figure from 100 to get your percentage of leakage.

    Example: If the second gauge reads 40 PSI, 40 divided by 60 equals approximately 66, and 66 from 100 leaves 33, so the leakage is 33 percent

11. Consult your service manual for the maximum allowable leakage, and record that figure here: ____________

    a. If you get an unallowable percentage of leakage, you can isolate the problem by listening for and feeling the source of the escaping air.

    (NOTE: This sometimes requires removing the exhaust pipe or the carburetor.)

    b. If the percentage of leakage is within allowable limits, then compression is okay.

☐ Have your instructor check your work before removing any test equipment.

12. Clean up area and return tools and materials to proper storage.

MOTORCYCLE ENGINES
UNIT VII

PRACTICAL TEST #1
JOB SHEET #1 — TROUBLESHOOT A NO-START COMPLAINT ON A ONE-CYLINDER MOTORCYCLE ENGINE

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Checked for proper spark.	2.	☐	☐
3. Made a dry compression test.	3.	☐	☐
4. Made a wet compression test.	4.	☐	☐
5. Checked the fuel system.	5.	☐	☐
6. Entered appropriate items on log.	6.	☐	☐
7. Cleaned area and returned tools to storage.	7.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

MOTORCYCLE ENGINES
UNIT VII

PRACTICAL TEST #2
JOB SHEET #2 — PERFORM A LEAK-DOWN TEST ON A ONE-CYLINDER MOTORCYCLE ENGINE

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Checked out proper equipment.	1.	☐	☐
2. Prepared safe work area.	2.	☐	☐
3. Wore safety glasses.	3.	☐	☐
4. Placed engine at TDC.	4.	☐	☐
5. Safely secured the crankshaft.	5.	☐	☐
6. Properly installed adapter in spark plug hole.	6.	☐	☐
7. Properly hooked up leakage tester to adapter.	7.	☐	☐
8. Properly hooked compressed air line to tester.	8.	☐	☐
9. Turned regulator knob slowly.	9.	☐	☐
10. Completed leak-down test.	10.	☐	☐
11. Recorded findings properly.	11.	☐	☐
12. Cleaned up area and returned tools.	12.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

MOTORCYCLE ENGINES
UNIT VII

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. Diameter of a cylinder

_____b. A manufacturing process that gives pistons an elliptical shape

_____c. The measurement of engine displacement on a metric scale

_____d. Area between the top of the piston and the cylinder head where the air/fuel mixture is ignited

_____e. Housing for the crankshaft, transmission, and related parts

_____f. Completion of the series of events required to produce a power impulse from an engine

_____g. Measurement of work done in a given period of time

_____h. A method of measuring pressure

_____i. The back and forth or up and down motion made by a piston

_____j. The measurement of turning or twisting force

1. Crankcase
2. Horsepower
3. Bore
4. Torque
5. Combustion chamber
6. Cam ground
7. cc
8. Cycle
9. Reciprocating motion
10. PSI

2. Complete statements concerning basic motorcycle engine theory by inserting the word(s) or number(s) that best completes each statement.

a. There are two major types of motorcycle engines:

1) ____________ cycle engines

2) ____________ cycle engines

b. In the two-stroke cycle engine, the cycle of events that produces power takes two strokes to complete or ____________ degrees of crankshaft rotation.

TEST

c. In the four-stroke cycle engine, the cycle of events that produces power takes four strokes to complete or ____________ degrees of crankshaft rotation.

d. Engines are usually designed to meet specific demands, and this requires a variety of engine shapes or ____________.

3. Match terms related to piston movement with their correct meanings.

_____a. The position of a piston at its highest point in a cylinder

_____b. The position of a piston at a point between TDC and halfway down the stroke

_____c. The position of a piston at a point between halfway up and TDC

_____d. The position of a piston at its lowest point in the cylinder

_____e. The position of a piston at a point between BDC and halfway up the stroke

_____f. The position of a piston at a point between halfway down and BDC

1. BTDC
2. ABDC
3. BBDC
4. TDC
5. ATDC
6. BDC

4. Complete statements concerning two-stroke and four-stroke operations by inserting the word(s) that best completes each statement.

a. The whole idea of an internal combustion engine is to create ____________ ____________ through combustion of the fuel/air mixture and convert that to mechanical energy through rotation of the crankshaft.

b. A four-stroke engine requires four distinct piston strokes to produce one power impulse.

1) The ____________ stroke

2) The ____________ stroke

3) The ____________ stroke

4) The ____________ stroke

c. Essentially, what happens in a four-stroke engine is what happens in a two-stroke engine except that the ____________ operation is more complex because the ____________ engine has intake and exhaust ports instead of valves.

d. The four-stroke engine can exhaust burned gases out of the exhaust valve, but the two-stroke engine has to force burned gases out an exhaust port in a unique way that is called ____________.

TEST

5. Match terms concerning major components of a four-stroke engine with their functions.

_____a. Contains the crankshaft, bearings, transmission, and other components of the lower engine

_____b. The shaft which changes reciprocating piston motion into rotary motion

_____c. Attaches the piston to the crankshaft

_____d. A cam ground cylinder that slides up and down in an engine cylinder and is attached to a connecting rod

_____e. Metal inserts fitted into the top of a piston to retain pressure as the piston moves

_____f. The hollow cylinder extending from the engine case to the cylinder head to house the piston and permit piston movement

_____g. The covering that closes the top end of the cylinder and may contain valves and cam shafts

_____h. Devices used to open and close intake and exhaust passages

_____i. Shafts with egg-shaped lobes that strike rocker arms to change rotary motion from the crankshaft into reciprocating motion to open valves

_____j. Allows for the irregularities in the mating surfaces of two parts to assure a leak-proof seal

1. Valves
2. Connecting rod
3. Piston
4. Gasket
5. Crankcase
6. Crankshaft
7. Cylinder
8. Camshafts
9. Rings
10. Cylinder head

TEST

6. Match terms concerning major components of a two-stroke engine with their functions.

_____a. Contains the crankshaft, bearings, transmission, and other components of the lower engine

_____b. The shaft which changes reciprocating piston motion into rotary motion

_____c. Attaches the piston to the crankshaft

_____d. A cam-ground cylinder that slides up and down in an engine cylinder and is attached to a connecting rod

_____e. Metal inserts fitted into the top of a piston to retain pressure as the piston moves

_____f. The hollow cylinder extending from the engine case that houses the piston and contains intake, transfer, and exhaust ports

_____g. The covering that closes the top end of the cylinder

_____h. Allows for irregularities in the mating surfaces of two parts to assure a leak-proof seal

1. Crankshaft
2. Cylinder head
3. Gasket
4. Connecting rod
5. Crankcase
6. Piston
7. Cylinder
8. Rings

7. Arrange in order the steps in the operation of a four-stroke engine by placing the correct sequence number in the appropriate blank.

_____a. As the piston reaches TDC, the spark plug ignites the air/fuel mixture and the combustion produces high pressure which forces the piston to move down.

_____b. As the piston moves up from BDC to TDC, both the intake and exhaust valves close and the air/fuel mixture in the cylinder is compressed.

_____c. The downward movement of the piston is carried through the connecting rod to the crankshaft, and it causes the crankshaft to rotate.

_____d. The 720 degree revolution of a four-stroke engine begins with the piston at TDC.

_____e. As the piston moves down to BDC, it creates a partial vacuum in the cylinder as the intake valve opens to allow the air/fuel mixture into the cylinder.

_____f. The piston has made four complete strokes, has completed a 720 degree rotation, and is at TDC once more as the cycle starts over.

_____g. As the piston completes the power stroke, and just before it reaches BDC, the exhaust valve opens and burned gases are forced out of the cylinder as the piston moves on up to TDC.

TEST

8. Arrange in order the steps in the operation of a two-stroke engine by placing the correct sequence number in the appropriate blank.

_____a. The fresh air/fuel mixture sweeps into the upper cylinder and quickly pushes out remaining exhaust gases from the cylinder in a scavenging action.

_____b. As the piston moves down, it closes the intake port and compresses the air/fuel mixture in the crankcase.

_____c. The 360 degree revolution of a two-stroke engine begins with the piston at BDC.

_____d. Just as the combustion chamber above the piston is filled with a fresh supply of air/fuel, the piston reaches BDC and starts the cycle over again.

_____e. As the piston moves upward, it clears the intake port and allows a fresh supply of the air/fuel mixture from the carburetor to enter the crankcase.

_____f. As the air/fuel mixture enters the crankcase, the piston moves past and closes the exhaust port as it compresses the air/fuel mixture above the piston.

_____g. As the piston moves even farther down, it opens the transfer port which allows the air/fuel mixture that has been compressed in the crankcase to enter the upper part of the cylinder.

_____h. As the piston reaches TDC, a spark ignites the compressed fuel/air mixture and drives the piston down with enough force that the power turns the crankshaft.

_____i. As the piston moves farther down it slides past the exhaust port which opens to allow burned gases to flow out of the cylinder.

9. Select true statements concerning four-stroke engine characteristics by placing an "X" in the blank beside each statement that is true.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Four stroke engines are typically found on street bikes and touring bikes because they are durable, reliable, and run more smoothly than two-stroke engines.

_____b. A four-stroke engine properly operated and maintained is virtually trouble free and will require as much service as a two-stroke engine.

_____c. Four stroke engines typically give poor gas mileage but generally give better performance in a wider power band.

TEST

_____d. Four-stroke engines have lower pollution levels in the exhaust emissions and four-stroke engines do meet EPA standards for exhaust emission control.

_____e. Four-stroke engines usually run a bit hotter than two-stroke engines.

_____f. Four-stroke engines are identified by:

1) Number of cylinders and valves per cylinder

2) Cylinder arrangements

3) Number of camshafts

4) Placement of camshafts

10. Select true statements concerning two-stroke engine characteristics by placing an "X" in the blank beside each statement that is true.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Two-stroke engines are typically used on off-road bikes and ATV's because they are lightweight, compact, powerful, and cost more than four-stroke engines.

_____b. Two-stroke engines have few moving parts and are easy to service, but require service more often.

_____c. Modern two-stroke engines have several improvements that enhance performance:

1) They are liquid cooled.

2) They have larger bores and shorter strokes.

3) They turn at a slower rpm, yet produce horsepower comparable to older type two-strokes because they produce more torque.

4) They have hi-tech coating on cylinder walls and pistons to improve durability.

5) They have improved exhaust design that decreases horsepower and improves performance

_____d. Almost all two-stroke engines use a reed valve induction system to control the intake flow of the fuel/air mixture.

_____e. Some two-stroke engines use some type of valve to control exhaust port timing and improve performance.

_____f. It's easy to find a two-stroke engine that meets the exhaust emission control standards set by the EPA.

TEST

11. Complete statements concerning problems that cause poor engine performance by inserting the word(s) that best completes each statement.

a. To perform well, an engine must have:

1) __________ __________ fuel

2) __________ compression

3) A __________ spark

b. Without the proper combination of __________, __________, and __________, an engine will not run smoothly and may not run at all.

c. The purpose of the __________ is to mix a specified amount of fuel with air to serve engine needs at all speeds.

d. Problems with carburetors can almost always be corrected with a complete __________, __________, __________, and __________.

e. Compression is affected by several conditions:

1) Improper __________ adjustment is the most common problem, especially on smaller engines.

2) Ring and piston wear or damage cause __________ __________.

3) A leaking __________ __________ __________ will cause poor compression.

4) Burned or __________ valves cause poor or no compression.

f. The lack of a strong spark may be caused by the malfunction of any part of the ignition system:

1) __________ __________ that are dirty, burned, worn, or improperly adjusted can cause a weak spark or no spark at all.

2) Defective __________ __________ in electronic ignition systems can cause a weak spark or no spark at all.

3) A weak __________ __________ like a battery or primary coil can cause a weak spark or no spark at all.

4) A defective __________ __________ __________ in an electronic ignition system can cause erratic spark, weak spark, or no spark at all.

5) __________ __________ that are disconnected, shorted, or damaged usually result in no spark at all.

g. For an engine to run smoothly, fuel, spark, and compression events must happen in a specific __________ and at a specific __________.

TEST

12. Complete the following list of tools required for basic engine troubleshooting by inserting the word(s) that best completes each statement.

    a. Basic ____________ tools

    b. ____________ shop towel

    c. One liter container for catching ____________

    d. A ____________ oil can with 30W oil in it

    e. A ____________ gauge set

    f. A spark ____________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

13. Demonstrate the ability to:

    a. Troubleshoot a no-start complaint on a one-cylinder motorcycle engine. (Job Sheet #1)

    b. Perform a leak-down test on a one-cylinder motorcycle engine. (Job Sheet #2)

MOTORCYCLE ENGINES
UNIT VII

ANSWERS TO TEST

1. a. 3
b. 6
c. 7
d. 5
e. 1
f. 8
g. 2
h. 10
i. 9
j. 4

2. a. 1) Two-stroke
2) Four-stroke
b. 360
c. 720
d. Configurations

3. a. 4
b. 5
c. 1
d. 6
e. 2
f. 3

4. a. Heat energy
b. 1) Intake
2) Compression
3) Power
4) Exhaust
c. Two-stroke, two-stroke
d. "Scavenging"

5. a. 5
b. 6
c. 2
d. 3
e. 9
f. 7
g. 10
h. 1
i. 8
j. 4

6. a. 5
b. 1
c. 4
d. 6
e. 8
f. 7
g. 2
h. 3

7. a. 4
b. 3
c. 5
d. 1
e. 2
f. 7
g. 6

8. a. h
b. 5
c. 1
d. 9
e. 2
f. 3
g. 7
h. 4
i. 6

ANSWERS TO TEST

9. a, d, f

10. b, d, e

11. a.
    1) Good quality
    2) Good
    3) Strong

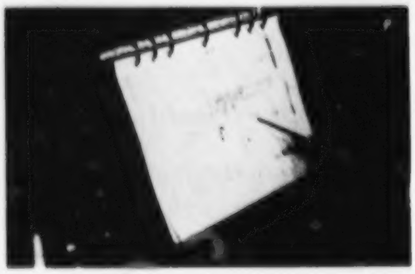
    b. Fuel, compression, spark
    c. Carburetor
    d. Disassembly, cleaning, reassembly, adjustment
    e.
    1) Valve
    2) Poor compression
    3) Cylinder head gasket
    4) Bent

    f.
    1) Ignition points
    2) Triggering coils
    3) Power source
    4) Ignition control unit
    5) Connecting wires

    g. Sequence, time

12. a. Hand
    b. Clean
    c. Gasoline
    d. Pump-type
    e. Compression
    f. Tester

13. Performance skills evaluated by practical tests



BATTERY AND ELECTRICAL SERVICE

UNIT VIII

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss battery service, battery safety, and battery identification. The student should also be able to splice and solder electrical wires, service and install a motorcycle battery, and troubleshoot with a test light. These competencies will be evidenced by correctly completing the procedures outlined in the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to battery and electrical service with their correct definitions.
2. Complete statements concerning batteries.
3. Select true statements concerning battery safety.
4. Solve problems concerning battery identification.
5. Complete statements concerning battery maintenance.
6. Complete statements concerning hydrometers.
7. Solve problems concerning electrical circuits.
8. Complete statements concerning systematic electrical troubleshooting.
9. Select true statements concerning test light troubleshooting.
10. Complete statements concerning voltmeter use.
11. Select true statements concerning types of splices.
12. Trace a motorcycle brake light circuit on a wiring diagram. (Assignment Sheet #1)

OBJECTIVE SHEET

13. Demonstrate the ability to:

    a. Service and charge a new motorcycle battery. (Job Sheet #1)

    b. Remove, clean, service, and install a motorcycle battery. (Job Sheet #2)

    c. Check the output of a charging system. (Job Sheet #3)

    d. Use a test light to verify voltage. (Job Sheet #4)

    e. Splice and solder electrical wires. (Job Sheet #5)

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparency.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Discuss battery safety and impress upon students the hazards of working with battery electrolyte.

H. Impress upon students the importance of wearing safety glasses at all times during battery service and importance of not putting their heads directly over a battery at any time or for any reason.

I. Demonstrate the procedure for disconnecting a battery, negative first, and for reconnecting a battery, positive first, and explain to students why the procedure is vital to safety.

J. Demonstrate the use of a test light and a voltmeter.

K. Demonstrate the use of a battery hydrometer, and how to read one.

L. Show a sulfated battery so students will have knowledge of what sulfation looks like.

M. Use video tapes as appropriate for visual reinforcement of objectives and job sheets. S1616—*Batteries and Their Service*; S1026—*Storage Batteries* are available at educational rates in ½" VHS or Beta video tapes from:

American Honda Motors Co., Inc.
Motorcycle VoTech
100 West Alondra Blvd.
Gardena, CA 90248-2702

N. Another video tape appropriate for this unit of instruction is *Battery Theory and Maintenance*. This video is available in ¾" U-Matic, ½" Beta I, ½" Beta II, or ½" VHS formats from:

Kawasaki Motors Corp., U.S.A.
Service Training
9950 Jeronimo Road
Irvine, CA 92718-2016

O. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Hires, Bill, Mark Taylor, and Mike Bundy. *Small Engine Repair Two-Stroke and Four-Stroke Cycle.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1985.

C. *Training Reference Materials.* Gardena, CA: American Honda Motor Co., Inc., 1985.

D. *1987 Yuasa Motorcycle and ATV Battery Specifications and Applications.* Reading, PA 19603: Yuasa General Battery Corporation, 1087.

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

INFORMATION SHEET

I. **Terms and definitions**

A. Ampere-hour capacity — The ability of a battery to deliver electricity as calculated by multiplying battery discharge current in amperes times the number of hours the battery is capable of supplying that current

Example: A 12 ampere-hour battery will deliver 12 amps for 1 hour or 1 amp for 12 hours

B. Amperes — The measurement of the current flow

C. Voltage — The measurement of electrical pressure

D. Ohms — The measurement of resistance to electrical flow

E. Soldering paste — A weak, acid flux that cleans a wire and improves the adhesive quality of a wire so that solder will adhere to the wire more readily

F. Solderless connections — Electrical connectors and terminals that are crimped to ends of wires

G. Tinning — Melting a small amount of solder onto the tip of a soldering gun to insure proper heat transfer from the tip of the gun to the area being soldered

II. **Batteries**

A. A battery is a device that stores electrical energy in chemical form.

B. Lead acid batteries used in motorcycles are built in groups of 2-volt cells.

C. Each cell of a battery contains 2 volts, and the cells can be arranged to form a 6-volt or a 12-volt battery.

Example: A 6-volt battery contains three 2-volt cells, and a 12-volt battery contains six 2-volt cells.

D. Lead acid reactions have limitations, and no matter how large a cell is, it will still contain only 2 volts of electricity.

E. The battery is primarily the energy source for starting the engine and running some lights; however, the generator or alternator supplies the electricity needed to run other lights and accessories and maintain the battery.

F. Another function of the charging system (generator/alternator) is to restore normal power to the battery after the battery has been partially discharged by starting.

INFORMATION SHEET

III. **Battery safety**

A. Always wear a face shield when you are working around a battery.

B. Always disconnect the negative battery cable FIRST when removing a battery and replace the negative cable LAST when installing a battery.

(NOTE: Remember to remove negative first, install negative last will help insure that you never short out the battery or cause a spark that could cause the battery to explode.)

C. Batteries emit toxic hydrogen gas which is very explosive, especially when a battery is being charged, so always charge a battery in a well ventilated area away from open flames or anything that could spark.

D. Because of toxic fumes and the potential for explosion, NEVER put your head directly over a battery when you are servicing one.

E. Battery electrolyte contains sulphuric acid and should never be allowed to contact your eyes, skin, or clothes.

F. Should you ever get electrolyte on your skin or clothes, apply baking soda immediately and wash it off with generous amounts of soap and water.

G. Should you ever get electrolyte in your eyes, remain calm, get assistance immediately, go to the eye flushing station, and wash your eyes out with generous amounts of clean water.

(NOTE: Persons who get acid in their eyes frequently panic and hurt themselves by running into something or by falling, and another problem is that people will get to the eye flushing station and instinctively keep their eyes closed which, of course, will not permit the water to wash away the acid.)

H. Always get immediate medical attention if you get acid in your eyes.

IV. **Battery identification**

A. Most motorcycle batteries use JIS (Japanese Industrial Standards) to indicate their construction and performance characteristics.

B. The combination of numbers and letters is used to indicate the voltage, amperage, and specific application for each battery as well as the country of manufacture.

Example: 12N12A-4A-1 indicates a 12-volt battery made in Japan (Nippon) with a 12 ampere-hour capacity; the 4 is a manufacturing code indicating post locations, the A is the position of the battery exhaust vent, and the 1 is another manufacturing code number for battery identification.

INFORMATION SHEET

C. For the technician, the most important thing about battery identification is the ampere-hour capacity rating which dictates the charging rate.

D. A battery charging rate should never exceed 10% of the ampere-hour rating.

Example: A 12 ampere-hour battery should be charged at the rate of 1.2 amps for 10 hours

E. Charging a battery at a rate of higher than 10% can cause the battery to overheat and destroy the battery.

(NOTE: Charging rates that are too high are a common cause of battery damage, and you can usually tell if the charging rate has been too high if it requires quite a bit of distilled water to top off the electrolyte in the cells.)

F. Using an automobile battery charger on a motorcycle battery will ruin the battery.

G. Jumping a motorcycle battery with a car battery will ruin the motorcycle battery and probably damage the motorcycle electrical system.

V. **Battery maintenance**

A. When a motorcycle comes in for service, the electrolyte level in the battery should always be checked.

B. The electrolyte level in the battery should be maintained with distilled water only.

C. A light coating of grease or petroleum jelly on the battery post will help to reduce corrosion and damage resulting from corrosion, but petroleum jelly should never be put on the battery case.

D. Terminals and cables can be cleaned with a mixture of baking soda and water, and the battery box can be cleaned with the same solution.

(CAUTION: Make sure the filler caps are in place so soda cannot get into battery cells.)

E. When inspecting a battery, always check for sulfation which will appear as whitish discoloration on the plates inside the battery because it means the battery is bad and you shouldn't waste time trying to charge it.

VI. **Hydrometers**

A. A hydrometer is a necessity for checking the specific gravity of the electrolyte in a battery cell.

B. Reading battery voltage with a voltmeter could give an acceptable reading even with one weak or bad cell, but only a hydrometer reading for specific gravity will indicate the condition of each individual cell.

INFORMATION SHEET

C. Specific gravity readings will not be accurate if they are taken immediately after adding distilled water to the electrolyte.

(NOTE: It takes about 30 minutes for distilled water to thoroughly mix with the acid.)

D. A specific gravity reading of 1.265 or above indicates a fully charged battery.

E. A specific gravity reading of less than 1.2 indicates that charging is required.

VII. Electrical circuits

A. The electrical system on a motorcycle is broken into circuits that work independently of each other.

Example: The brake light works off its own circuit and the turn signals work off a circuit of their own

B. Most motorcycles have eight circuits:

1. Ignition circuit
2. Charging circuit
3. Headlight and tail light circuit
4. Brake light circuit
5. Horn circuit
6. Turn signals circuit
7. Engine warning light circuit
8. Accessory circuit

C. Motorcycle circuits are not complex or really too difficult to troubleshoot because wiring diagrams are easy to read, and the wires are color coded for easy tracing.

Example: Motorcycle manufacturers have standard color codes, and what a red wire does on one bike, it will do the same thing on all other bikes made by that manufacturer

INFORMATION SHEET

VIII. **Systematic electrical troubleshooting**

A. Systematic electrical troubleshooting means isolating a problem in as short a time as possible.

B. Systematic troubleshooting means doing things with procedures that have been proven efficient.

C. Some of the elements of systematic troubleshooting include:

1. Clearly understanding the customer's complaint
2. Having the proper wiring diagram available to locate the components in the affected circuit
3. Knowing the colors of wires you will be looking for and testing
4. Knowing the location of plug-in and soldered connections where troubles are most likely to occur
5. Knowing the routes that wires take so you can physically trace them on the bike
6. Having the proper test equipment to measure electrical activity

D. By splitting a circuit in half, the problem can be isolated to the front half or the back half of the circuit.

Example: When you look at a wiring diagram you can determine, pretty much, the mid-way point of a circuit, and if you determine that voltage is present from the source to the mid-point, then the problem is in the other half of the circuit

E. By continuing to split the circuit in half, you can quickly isolate the trouble area.

IX. **Test light troubleshooting**

A. Because a test light requires no adjustment, is almost indestructable, and is suitable for almost all electrical troubleshooting, it is the handiest troubleshooting instrument of all.

B. A test light will only indicate the presence of voltage, not the amount of voltage, but most readings made in electrical troubleshooting require no more than the knowledge that voltage is or is not present.

C. A test light cannot be used to measure battery voltage, resistance, the output of a charging system or any condition that requires knowing specific voltage or resistance.

INFORMATION SHEET

D. As entry-level technicians gain skills, they will find that it is important to learn to use other more sophisticated test instruments such as a VOM or a service tester.

E. Entry level technicians who develop good skills with a test light will find learning to use more sophisticated test instruments much easier.

X. **Voltmeter use**

A. When you need to know the specific voltage in a circuit or circuit component, a voltmeter must be used.

B. Although senior technicians use voltmeters and VOM's for sophisticated diagnosis, entry-level technicians mostly use a voltmeter to test battery voltage.

C. Testing a battery with voltmeter is a simple procedure:

1. Set the voltmeter on 10V DC to check a 6-volt system, or on 20V DC to check a 12-volt system.
2. Place the red probe on the positive battery post.
3. Place the black probe on the negative battery post.
4. Read the results from the proper scale.

D. A standard voltmeter reading with engine off and all lights on should show a minimum of 10.5 volts.

E. A standard voltmeter reading with the starter engaged should not drop below 8.5 volts.

XI. **Splicing and soldering**

A. The two most common splices used around motorcycle wires are the simple straight splice and the tap splice.

B. A simple straight splice requires removing about half an inch of insulation from each wire to be spliced and twisting the two wires together.

C. A simple splice should be completed by soldering the splice area to insure a permanent connection, and then insulated with shrink tubing or electrical tape.

D. A tap splice requires removing about half an inch of insulation from the wire to be tapped into and half an inch of insulation from the end of the tap wire.

INFORMATION SHEET

E. A tap splice should also be completed by wrapping the tap wire around the straight wire, and soldered and insulated.

F. Simple splices are used mostly to repair broken wires, and tap splices are used mostly for the addition of accessory lights and other electrical add-ons.

G. Before making a tap splice, be certain that the electrical system will support the additional requirements that the accessory will add to the circuit.

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

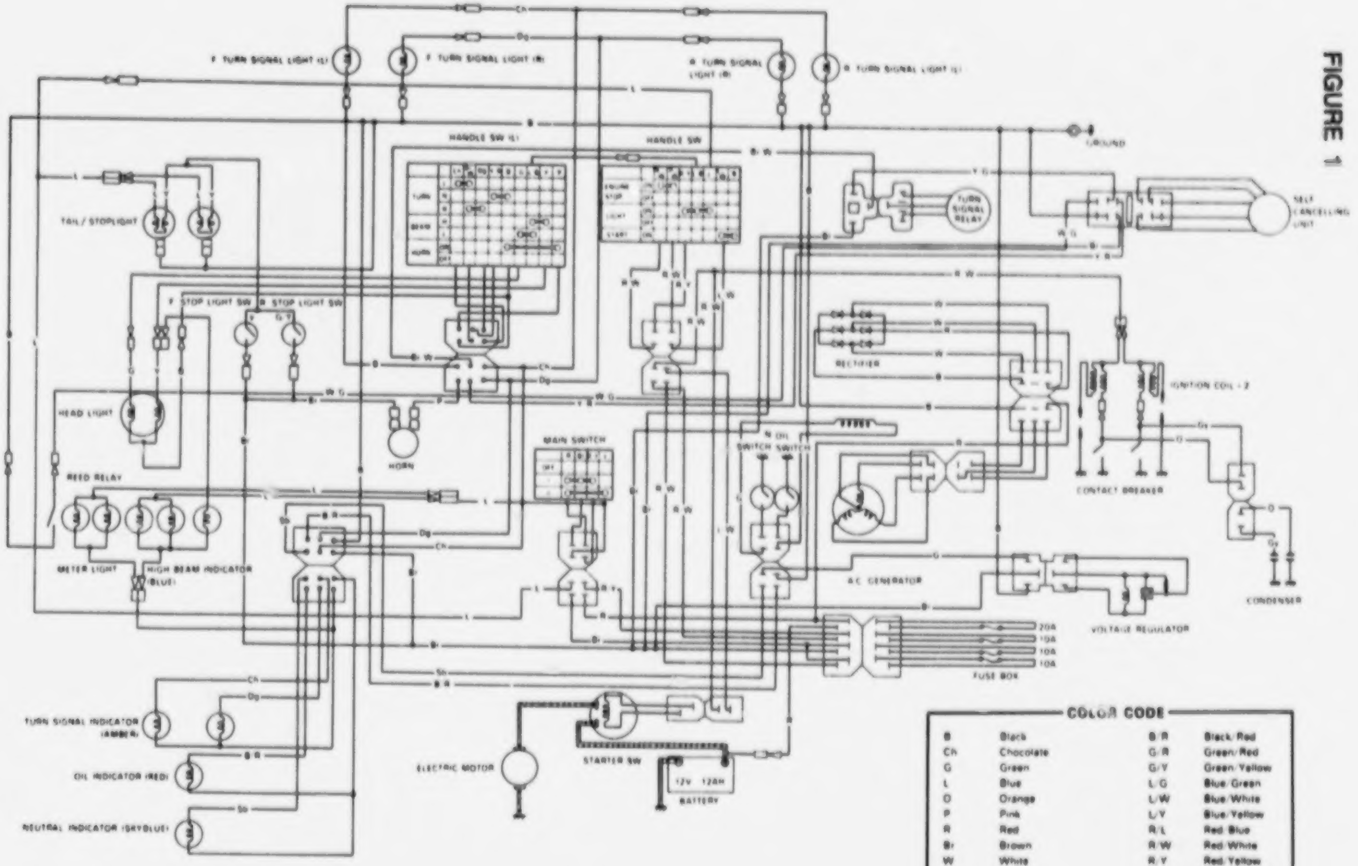
ASSIGNMENT SHEET #1 — TRACE A MOTORCYCLE BRAKE LIGHT CIRCUIT ON A WIRING DIAGRAM

Directions: Refer to the color codes listed in Figure 1 to find the colors of the wires that you will need to trace. Use a marking pen to trace the brake light circuit from the brake light back to the battery, including the grounding circuit. Study the accompanying Figure 1 wiring diagram fold-out carefully before you start marking, and use the following hints to approach the problem systematically. Be sure to make all entries in the Circuit Log that accompanies this assignment sheet.

1. Start at the brake light.
2. Reference Figure 1 to make sure you know which is the brake light wire as opposed to the tail light wires, and that you do not confuse hot wires with ground wires.
3. Locate the component parts of the circuit: the rear brake light and its connections, the front brake light switch and its connections, and any other connections that may be in the circuit because connections and switches are the most likely points of trouble.
4. Locate the brake light circuit fuse and see what other circuit it protects because if the other circuit is not functioning and the brake light circuit is not functioning, then you can be almost certain that the trouble is a blown fuse.

ASSIGNMENT SHEET #1

FIGURE 1


F TURN SIGNAL LIGHT (L)
F TURN SIGNAL LIGHT (R)
R TURN SIGNAL LIGHT (R)
R TURN SIGNAL LIGHT (L)
GROUND
HANDLE SW (L)
HANDLE SW
TURN
BEAM
HORN
ENGINE STOP
LIGHT
START
TURN SIGNAL RELAY
SELF CANCELLING UNIT
TAIL / STOPLIGHT
F STOP LIGHT SW
R STOP LIGHT SW
HEAD LIGHT
HORN
RECTIFIER
IGNITION COIL × 2
MAIN SWITCH
N SWITCH
OIL SWITCH
CONTACT BREAKER
REED RELAY
METER LIGHT
HIGH BEAM INDICATOR (BLUE)
A.C. GENERATOR
CONDENSER
VOLTAGE REGULATOR
20A
10A
10A
10A
FUSE BOX
TURN SIGNAL INDICATOR (AMBER)
OIL INDICATOR (RED)
NEUTRAL INDICATOR (SKYBLUE)
ELECTRIC MOTOR
STARTER SW
12V 12AH
BATTERY

Courtesy Kawasaki Motors Corp., U.S.A.

COLOR CODE

B	Black	B/R	Black/Red
Ch	Chocolate	G/R	Green/Red
G	Green	G/Y	Green/Yellow
L	Blue	L/G	Blue/Green
O	Orange	L/W	Blue/White
P	Pink	L/Y	Blue/Yellow
R	Red	R/L	Red/Blue
Br	Brown	R/W	Red/White
W	White	R/Y	Red/Yellow
Y	Yellow	W/G	White/Green
Dg	Dark green	Y/B	Yellow/Black
Gy	Gray	Y/G	Yellow/Green
Lg	Light green	Y/R	Yellow/Red
Sb	Sky blue	Br/W	Brown/White

ASSIGNMENT SHEET #1

Circuit Log

1. What color is the wire leading from the brake light back to the switches?

   ____

2. What color is the wire from the brake light switches to the fuse?

   ____

3. Is the color of wire from the brake light switches to the fuse present anywhere else on the wiring diagram?

   ____

4. What color is the wire leading from the fuse and from what power source does it originate?

   ____

5. What condition has to exist for the wire leading from the power sources to the fuse to be hot?

   ____

6. What color is the wire leading from the ignition switch to the battery?

   ____

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

ANSWERS TO ASSIGNMENT SHEET

1. Green with a yellow stripe
2. White with a green stripe
3. No
4. Black, and it comes from the ignition switch
5. The ignition switch must be ON
6. Red

   (NOTE: The actual tracing of the circuit should be evaluated on accuracy and completeness.)

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

JOB SHEET #1 — SERVICE AND CHARGE A NEW MOTORCYCLE BATTERY

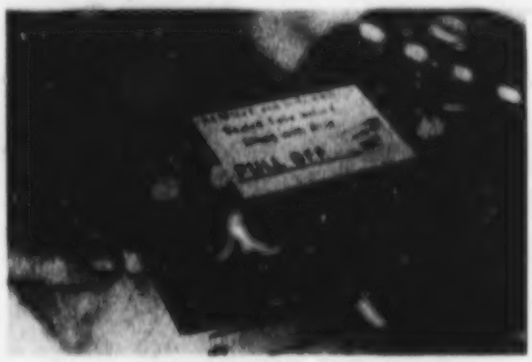
A. Tools and materials

1. Battery as selected by instructor
2. Battery acid as required
3. Motorcycle battery charger
4. Basic hand tools
5. Battery hydrometer
6. Battery voltmeter
7. Clean shop towels
8. Pencil
9. Face shield

B. Procedure

1. Put on a face shield
2. Unseal the battery by removing the rubber sealing cap from where the vent tube will go. (Figure 1)

FIGURE 1



3. Listen for a hiss of air as you pull the sealing cap off, because this will indicate the battery vacuum seal is intact and charging time will be less.

JOB SHEET #1

4. Attach the vent tube, making sure that it is free of obstructions and not kinked, and if it is kinked reshape it by dipping it in hot water for a few minutes. (Figure 2)

FIGURE 2

5. Remove the filler caps. (Figure 3)

FIGURE 3

6. Fill the battery cells with electrolyte and permit it to stand for about half an hour. (Figure 4)

(NOTE: Check specifications because the time may be more or less than half an hour.)

FIGURE 4

JOB SHEET #1

7. Wait until the bubbling stops, and top off each cell with electrolyte up to the upper level line marked on the battery case. (Figure 5)

FIGURE 5

8. Replace the battery caps.

☐ Have your instructor check your work.

9. Make sure the battery charger is turned off, or better yet, not plugged in.

10. Hook the battery charger positive cable onto the battery positive post first.

    (NOTE: The charger is off or unplugged and there is no danger at this point, but always make it a practice when working with a battery to hook up positive first, negative last, and to unhook negative first, positive last.)

11. Hook the battery charger negative cable onto the battery negative post next.

12. Make sure the battery is positioned in an area where it cannot damage anything near it in the event battery acid may leak out during charging.

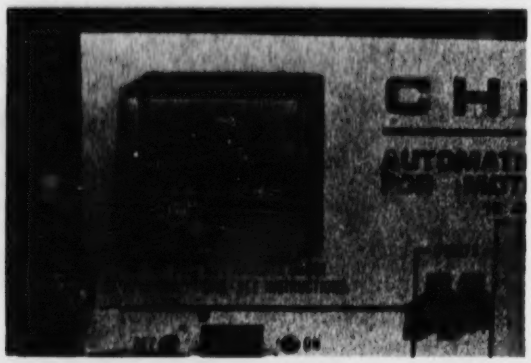
13. Plug the charger into an appropriate outlet and turn the charger on to the lowest charging range. (Figure 6)

FIGURE 6

JOB SHEET #1

14. Check the battery ampere-hour rating on the case and do not exceed a charging rate of more than 10% of that rating. (Figure 7)

FIGURE 7



15. Determine the date of manufacture stamped below the gas vent on the battery case, and figure charging time according to the following schedule:

Months elapsed since manufacture*	Charging hours
Less than 12 months	3 hours
12 to 18 months	5 hours
18 to 24 months	10 hours
More than 24 months	15-20 hours

16. Feel the battery case from time to time as it is charging to make sure electrolyte temperature does not go beyond the safe limit of 113°F.

    (CAUTION: If you think the electrolyte may be getting too hot, turn the charger off and check the electrolyte temperature with the temperature gauge on the hydrometer.)

17. Permit the battery to charge for the specified time, and remember that in a service department you would be doing other jobs while the battery charges.

18. Turn the charger off, remove the charging cables, negative first, then positive, and unplug the charger.

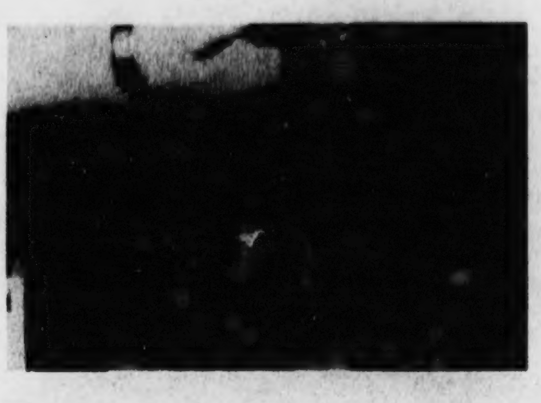
19. Let the battery sit for 5 to 10 minutes and then remove the filler caps.

JOB SHEET #1

20. Use a battery hydrometer designed for checking motorcycle batteries, and check the specific gravity of the electrolyte in each cell.

21. Insert the hydrometer into a cell, squeeze the hydrometer bulb, and draw electrolyte into the hydrometer tube until it raises the float from the bottom of the tube and the tube is floating freely. (Figure 8)

FIGURE 8



22. Check the specific gravity as indicated by the electrolyte level on the hydrometer gauge and write down the specific gravity for the first cell on the service log that accompanies this job sheet.

23. Repeat the procedure for each cell and enter your specific gravity readings on the service log.

24. Replace the filler caps and return the hydrometer to proper storage.

25. Use a battery volt meter to check the voltage stored in the battery and write your reading on the service log. (Figure 9)

FIGURE 9

☐ Have your instructor check your work.

26. Clean up area and return tools and materials to proper storage.

JOB SHEET #1

Battery Service Log

1. Specific gravity readings:

Cell #1 ____________________

Cell #2 ____________________

Cell #3 ____________________

Cell #4 ____________________

Cell #5 ____________________

Cell #6 ____________________

2. Voltage reading: ____

Your name ____ Date ____________

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

JOB SHEET #2 — REMOVE, CLEAN, SERVICE, AND INSTALL A NEW MOTORCYCLE BATTERY

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Wire brush
6. Baking soda
7. Distilled water
8. Face shield

B. Procedure

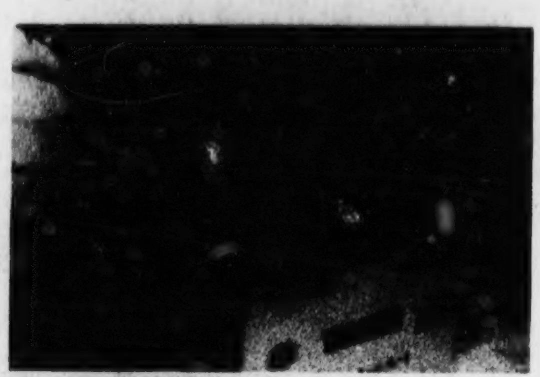
1. Put on a face shield.
2. Secure the bike in an upright position so that it is safely away from sparks or flames.
3. Locate the battery.
4. Remove the negative battery cable.
5. Remove the positive battery cable.
6. Disconnect the vent tube.
7. Remove the bracket, clamp, or rubber strap that holds the battery in place.
8. Remove the battery from its protective case.
9. Place the battery in a convenient area on a workbench. (Figure 1)

FIGURE 1

JOB SHEET #2

10. Clean the corrosion and dirt from both battery posts with a wire brush or baking soda and water. (Figure 2)

FIGURE 2



11. Wash the battery off with clean water and dry it with a shop towel. (Figure 3)

(NOTE: Be sure you are able to see into the battery to check electrolyte level and see the condition of the cells.)

FIGURE 3

12. Look at the battery cells carefully to see if there is a whitish looking build-up between the plates and if the plates appear to be corroded together.

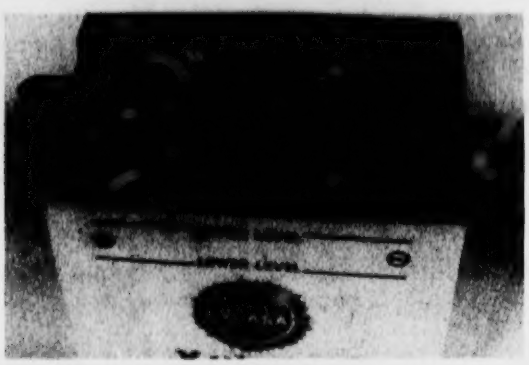
13. Check every cell carefully for the presence of whitish sulfation, and if sulfation is present on all or any one of the cells, the battery should probably be replaced.

14. Inspect the battery case for cracks or damage that would indicate the battery has been frozen, and if such damage is present, the battery should be replaced.

JOB SHEET #2

15. Inspect the battery posts to see if there is damage from corrosion or cracks caused by overtightening, and if the damage is too severe, the battery should be replaced. (Figure 4)

FIGURE 4



16. Confirm that the battery appears to be okay, and then top off each cell with distilled water and replace the filler caps. (Figure 5)

FIGURE 5

17. Hook the battery up to a battery charger as outlined in Job Sheet #1.

18. Charge the battery for a minimum of 10 hours at 10% of its ampere-hour capacity, and don't be alarmed if it takes thirty minutes to an hour for charging to start.

19. Turn the charger off and unhook the battery after charging.

20. Remove the filler caps and check each cell with a hydrometer as outlined in Job Sheet #1.

21. Replace the filler caps, and if the hydrometer indicates the battery is fully charged, it is ready to put back in place.

☐ Have your instructor check your work.

JOB SHEET #2

22. Use a wire brush to clean corrosion or dirt from the battery cable ends until the metal connectors appear bright and shiny, and clean the connector bolts and nuts.

23. Inspect the battery cable ends for damage from corrosion or overtightening, and if the damage is too severe the cables should be replaced.

24. Use a baking soda and water mixture and a wire brush to clean the protective case that holds the battery, and then dry it with a clean shop towel.

25. Install the battery back into its protective case and secure it with its support clamp or bracket.

26. Install the vent tube, and doublecheck to make sure it is free of kinks or short bends and that it is properly routed. (Figure 6)

FIGURE 6

27. Coat each battery post lightly with light grease or vaseline.

28. Install the positive battery cable first.

29. Install the negative battery cable last.

☐ Have your instructor check your work.

30. Clean up the area and return tools and materials to proper storage.

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

JOB SHEET #3 — CHECK THE OUTPUT OF A CHARGING SYSTEM

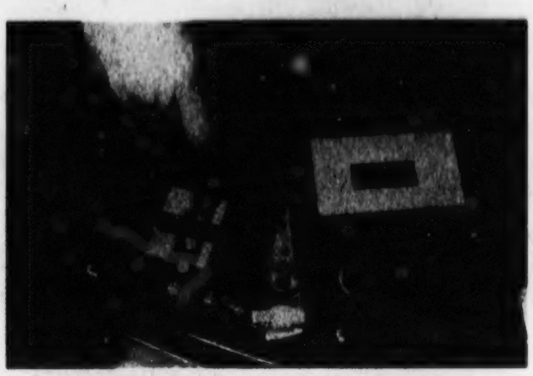
A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Clean shop towel
4. Voltmeter
5. Face shield

B. Procedure

1. Put on a face shield.
2. Secure the motorcycle so it can be safely started.
3. Set your meter to read voltage anticipated from the battery.
4. Clip the red lead to the positive battery terminal and the black lead to the negative battery terminal.
5. Note the battery voltage reading on the meter. (Figure 1)

FIGURE 1



6. Watch the meter as you start the motorcycle.

JOB SHEET #3

7. Note how far the voltage drops. (Figure 2)

FIGURE 2

8. Compare the voltage drop with the specifications in the service manual.

    a. If the voltage drops down to about 8 or 9 volts, the starting system is probably okay.

    b. If the voltage drops down below 8 volts, chances are the problem is in the starter itself.

9. Start the motorcycle.

10. Watch the volt meter, and as you slowly accelerate the engine, you should see a noticeable increase in voltage, up to 15 volts.

    a. If the volts reading does increase to 15 volts or slightly beyond, the charging system is okay.

    b. If the voltage reading does not increase to 15 volts, the charging system needs to be serviced.

11. Shut the motorcycle off.

☐ Have your instructor check your work.

12. Clean up area and return tools and materials to proper storage.

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

JOB SHEET #4 — USE A TEST LIGHT TO VERIFY VOLTAGE

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Test light
4. Face shield and safety glasses

B. Procedure

(NOTE: When a customer complaint states that a brake light is not working, the following troubleshooting procedure will quickly isolate the problem.)

1. Put on a face shield and run your test light lines across the battery terminals to make sure the test light is working.

   (NOTE: Wear safety glasses for the rest of this procedure.)

2. Find the wiring diagram in the service manual, locate all wires from the battery through the fuse on through the front and rear brake light switches, and on to the brake light. (Figure 1)

FIGURE 1

JOB SHEET #4

3. Hook the alligator clip on the test light to a known good ground such as the engine or the negative terminal of the battery. (Figure 2)

   (NOTE: Even when a fuse looks okay, never assume it is okay until you check it with the following procedure because the appearance of the fuse can easily hide a bad solder connection within the fuse itself, and loose ends cannot be detected with a visual inspection.)

FIGURE 2

4. Turn the ignition ON.

5. Place the test light probe on the wire leading TO the fuse at a point near the fuse receptacle. (Figure 3)

FIGURE 3

   a. If the test light lights up, you're getting power from the power source into the fuse.

   b. If the test light does not light up, you have isolated the problem in the power source.

JOB SHEET #4

6. Leave the ignition switch ON and place the test light probe on the wire leading FROM the fuse at a point near the fuse receptacle. (Figure 4)

FIGURE 4

a. If the test lights up, the fuse is okay, and the trouble is on down the line.

b. If the test light doesn't light up, replace the fuse and then check the new fuse.

(NOTE: Fuses don't just burn out, they usually blow because there's a short in the circuit, so when checking the new fuse always assume there may be a pinched wire, bare wire, or a shorted circuit somewhere down the line.)

7. Remove the brake light lens and brake light bulb. (Figure 5)

FIGURE 5

8. Hook the alligator clip of the test light to a known ground such as the battery or the engine.

JOB SHEET #4

9. Hold the brake lever or brake pedal down, put the test light probe on the brake light bulb contact point in the bulb housing, and watch for the test light to light up. (Figure 6)

FIGURE 6

a. If the test light lights up, it means the brake light bulb is bad and should be replaced.

b. If the test light does not light up, it means the problem is farther up the line.

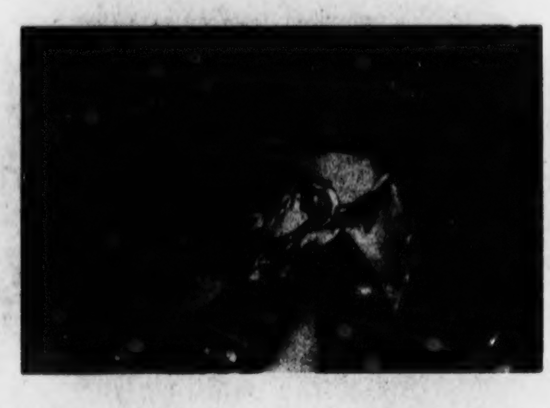
10. Take the test light alligator clip off the first ground and attach it to the brake light housing. (Figure 7)

FIGURE 7

JOB SHEET #4

11. Put the test light probe on the brake light bulb contact point and watch for the test light to light. (Figure 8)

FIGURE 8



   a. If the light does not light up, it could mean a bad ground or no ground in the brake light assembly.

   b. If the test light lit previously on a different ground and does not light now, you have isolated the problem to the brake light assembly.

   c. The problem could be in the brake light housing, but is probably a faulty ground wire to the housing or a faulty connection in the vicinity of the housing.

12. Move to the rear brake light switch and check the power into and out of the switch. (Figure 9)

FIGURE 9

   a. If you have power in and out, the switch is okay.

   b. If you have power in, but no power out, the switch should be replaced.

   c. If you have no power in, you'll have to keep troubleshooting up the lines especially at connections and places where wires bend.

JOB SHEET #4

13. Move to the front brake light switch and check the power into and out of the switch. (Figure 10)

FIGURE 10

a. If you have power in and out, the switch is okay.

b. If you have power in, but no power out, the switch should be replaced.

c. If you have no power in, the trouble lies between the switches and the power source.

d. Find the connections between the fuse and the front and rear brake light switches and check them. (Figure 11)

(NOTE: These might be in a multi-pin connection in the headlight assembly, or they may be soldered connections down line from the fuse, and if they are down line, the connections could be difficult to find, so start at the fuse and work your way down.)

FIGURE 11

JOB SHEET #4

14. Keep your alligator clip on a good ground and keep troubleshooting until you find the problem. (Figure 12)

    (NOTE: Troubleshooting may take a little time, but be patient and you will find the break in the wire or the bad connection that is causing the problem.)

FIGURE 12

☐ Have your instructor check your work.

15. Replace the bulb and brake light lens.

16. Clean up area and return tools and materials to proper storage.

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

JOB SHEET #5 — SPLICE AND SOLDER ELECTRICAL WIRES

A. Tools and materials

1. Wires as selected by instructor
2. 150/250 watt soldering gun
3. Resin-core solder
4. Clean shop towel
5. Soldering paste
6. Combination stripping/crimping tool
7. Electrical tape
8. Shrink tubing
9. Safety glasses

B. Routine #1 — Making a straight splice

1. Put on safety glasses.
2. Check the area to make sure it is free of combustible materials and that there is a fire extinguisher nearby.
3. Take the solid piece of wire and cut it in two.
4. Use the stripping tool to cut and remove about half an inch from each end of the wire. (Figure 1)

FIGURE 1

JOB SHEET #5

5. Overlap the two bare ends of wire so that each end butts the insulation on the opposing wire.

6. Twist the two bare wires together so that they are tight enough to hold and the wires form a smooth joint. (Figure 2)

FIGURE 2

7. Dip the tip of screwdriver in soldering paste or squeeze a small amount of paste onto the screwdriver tip and lightly coat the exposed splice.

8. Turn the soldering gun on and allow it to heat up enough that you can melt a small amount of solder onto the tip to tin it. (Figure 3)

(NOTE: Tinning the tip will assure proper heat transfer so never leave this step out of any soldering activity.)

FIGURE 3

JOB SHEET #5

9. Place the tip of the gun on the exposed splice at about mid-point to avoid burning the insulation at the sides.

10. Heat the wire until it is hot enough to melt the solder as you hold the solder lightly on the splice. (Figure 4)

FIGURE 4

11. Permit the solder to run the length of the splice in both directions until it completely covers the spliced area. (Figure 5)

FIGURE 5

12. Remove the soldering gun from the splice and put it in a place where it can safely cool down.

13. Permit the spliced wire to cool.

14. Inspect the splice to make sure it is smooth and complete, and if there is an excess of solder at any point, heat the soldering gun again and smooth the excess out.

(NOTE: A sharp point or peak of solder can cut the insulation and cause the wire to short.)

☐ Have your instructor check your work.

JOB SHEET #5

C. Routine #2 — Using shrink tubing to insulate a splice

1. Leave your safety glasses on.
2. Cut the shrink tubing so that it is about twice as long as the splice.
3. Slip the shrink tubing over a free end of one wire. (Figure 6)

   (NOTE: Splicing a wire that is on a bike usually requires that the shrink tubing be placed on the wire before splicing and soldering begins, and the tubing must be far enough removed from the splice area that soldering heat will not melt it.)

FIGURE 6

4. Center the shrink tubing over the splice and direct hot air from a heat gun onto entire length of the shrink tubing until the tubing adheres tightly to the splice and to the insulation on both sides. (Figure 7)

   (NOTE: The flame from a match or lighter will also shrink the tubing, but avoid overheating.)

FIGURE 7

☐ Have your instructor check your work.

JOB SHEET #5

D. Routine #3 — Making a tap slice

1. Leave your safety glasses on.

2. Cut a section of insulation about a half inch long from the wire you plan to tap into.

   (NOTE: Select the proper wire gauge number on the stripper tool so you'll cut only the insulation and not cut the wire.)

3. Strip about half an inch of insulation off the end of the wire you are using to make the tap.

4. Wrap the end of the wire you're making the tap with tightly around the half inch space on the wire you're tapping into.

5. Place a dab of soldering paste onto the splice area.

6. Turn on the soldering iron and allow it to get hot enough that you can touch the tip with solder and properly tin the tip.

7. Place solder on the heated area and permit it to flow onto the wires until the wires are completely coated with solder. (Figure 8)

FIGURE 8

8. Remove the soldering gun and put it in a place where it can safely cool down.

9. Permit the tap slice to cool.

JOB SHEET #5

10. Inspect the splice to make sure it is smooth and complete, and if there is an excess of solder at any point, heat the soldering gun again and smooth the excess out. (Figure 9)

FIGURE 9

☐ Have your instructor check your work.

11. Start with the tap wire and wrap electrical tape around it about two times and then make smooth figure eights over the other wire so that the figure eights overlap enough to provide a good layer of insulation. (Figure 10)

FIGURE 10

☐ Have your instructor check your work.

12. Clean up area and return tools and materials to proper storage.

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

PRACTICAL TEST #1
JOB SHEET #1 — SERVICE AND CHARGE A NEW MOTORCYCLE BATTERY

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore a face shield.	1.	☐	☐
2. Unsealed batter and checked vacuum seal.	2.	☐	☐
3. Attached vent tube properly.	3.	☐	☐
4. Removed filler caps properly.	4.	☐	☐
5. Filled the battery with electrolyte.	5.	☐	☐
6. Permitted battery to stand for appropriate time.	6.	☐	☐
7. Topped off each cell with electrolyte.	7.	☐	☐
8. Hooked battery charger to battery properly.	8.	☐	☐
9. Charged the battery for proper ampere-hour rating.	9.	☐	☐
10. Charged battery properly.	10.	☐	☐
11. Checked specific gravity of each cell with hydrometer.	11.	☐	☐
12. Recorded hydrometer readings on log.	12.	☐	☐
13. Replaced filler caps.	13.	☐	☐
14. Used voltmeter to check battery voltage.	14.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

PRACTICAL TEST #2
JOB SHEET #2 — REMOVE, CLEAN, SERVICE, AND INSTALL A MOTORCYCLE BATTERY

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore a face shield.	1.	☐	☐
2. Removed cables in proper order.	2.	☐	☐
3. Disconnected vent tube and properly removed battery.	3.	☐	☐
4. Cleaned battery and checked for sulfation.	4.	☐	☐
5. Inspected battery posts and case for damage.	5.	☐	☐
6. Charged battery properly.	6.	☐	☐
7. Removed filler caps and checked specific gravity of each cell with hydrometer.	7.	☐	☐
8. Checked and cleaned battery cables and posts.	8.	☐	☐
9. Routed vent tube properly.	9.	☐	☐
10. Coated battery posts with vaseline.	10.	☐	☐
11. Replaced battery and hooked up cables in order.	11.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

PRACTICAL TEST #3
JOB SHEET #3 — CHECK THE OUTPUT OF A CHARGING SYSTEM

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore a face shield.	1.	☐	☐
2. Set voltmeter for anticipated voltage.	2.	☐	☐
3. Placed VOM leads properly on battery posts.	3.	☐	☐
4. Checked meter and noted voltage.	4.	☐	☐
5. Started bike and noted voltage drop.	5.	☐	☐
6. Compared voltage drop with specifications.	6.	☐	☐
7. Started bike and noted increase in voltage.	7.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #3 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

PRACTICAL TEST #4
JOB SHEET #4 — USE A TEST LIGHT TO VERIFY VOLTAGE

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore a face shield.	1.	☐	☐
2. Located wires on wiring diagram.	2.	☐	☐
3. Hooked alligator clip to proper ground.	3.	☐	☐
4. Turned ignition ON.	4.	☐	☐
5. Verified voltage in and out of fuse.	5.	☐	☐
6. Verified voltage at brake light bulb.	6.	☐	☐
7. Verified voltage at brake light assembly.	7.	☐	☐
8. Verified voltage at rear brake light switch.	8.	☐	☐
9. Verified voltage at front brake light switch.	9.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #4 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

Tools and Equipment	**Properly selected and properly used** **4**	**Properly selected and acceptably used** **3**	**Poorly selected and/or used** **2**	**Improperly selected and/or used** **1**
Materials	**Properly selected and properly used** **4**	**Properly selected and acceptably used** **3**	**Poorly selected and/or used** **2**	**Improperly selected and/or used** **1**
Procedure	**Properly followed** **4**	**Acceptably followed** **3**	**Poorly followed** **2**	**Improperly followed** **1**
Safety	**Carefully observed** **4**	**Acceptably observed** **3**	**Poorly observed** **2**	**Improperly observed** **1**

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

PRACTICAL TEST #5
JOB SHEET #5 — SPLICE AND SOLDER ELECTRICAL WIRES

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Prepared wires for straight splice.	2.	☐	☐
3. Tinned soldering iron and completed straight splice.	3.	☐	☐
4. Prepared wires for shrink tubing.	4.	☐	☐
5. Completed splice with shrink tubing.	5.	☐	☐
6. Prepared wires for tap splice.	6.	☐	☐
7. Tinned soldering iron and completed tap splice.	7.	☐	☐
8. Wrapped splice with electrical tape.	8.	☐	☐
9. Cleaned up area and returned tools to storage.	9.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #5 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

______a. The ability of a battery to deliver electricity as calculated by multiplying battery discharge current in amperes times the number of hours the battery is capable of supplying that current

______b. The measurement of the current flow

______c. The measurement of electrical pressure

______d. The measurement of resistance to electrical flow

______e. A weak, acid flux that cleans a wire and improves the adhesive quality of a wire so that solder will adhere to the wire more readily

______f. Electrical connectors and terminals that are crimped to ends of wires

______g. Melting a small amount of solder onto the tip of a soldering gun to insure proper heat transfer from the tip of the gun to the area being soldered

1. Voltage
2. Solderless connections
3. Ohms
4. Tinning
5. Ampere-hour capacity
6. Amperes
7. Soldering paste

2. Complete statements concerning batteries by inserting the word(s) or figure(s) that best completes each statement.

a. A battery is a device that stores electrical energy in ____________ form.

b. Lead acid batteries used in motorcycles are built in groups of ____________-volt cells.

c. Each cell of a battery contains ____________ volts, and the cells can be arranged to form a ____________-volt or a 12-____________volt battery.

d. Lead acid reactions have limitations, and no matter how large a cell is, it will still contain only ____________ volts of electricity.

TEST

e. The battery is primarily the energy source for starting the engine and running some lights; however, the generator or alternator supplies the electricity needed to run other lights and accessories and ____________ the battery.

f. Another function of the charging system (generator/alternator) is to restore normal power to the battery after the battery has been partially discharged by ____________.

3. Select true statements concerning battery safety by placing an "X" beside each statement that is true.

_____a. Always wear a face shield when you are working around a battery.

_____b. Always disconnect the positive battery cable FIRST when removing a battery and replace the positive cable LAST when installing a battery.

_____c. Batteries emit toxic hydrogen gas which is very explosive, especially when a battery is being charged, so always charge a battery in a well ventilated area away from open flames or anything that could spark.

_____d. Because of toxic fumes and the potential for explosion, NEVER put your head directly over a battery when you are servicing one.

_____e. Battery electrolyte contains sulphuric acid and should never be allowed to contact your eyes, skin, or clothes.

_____f. Should you ever get electrolyte on your skin or clothes, immediately wash it off with water.

_____g. Should you ever get electrolyte in your eyes, remain calm, get assistance immediately, go to the eye flushing station, and wash your eyes out with generous amounts of water.

_____h. Always get immediate medical attention if you get acid in your eyes.

4. Solve the following problems concerning battery identification.

a. You notice a fellow technician charging a battery at a rate of 3.5 amps, and you note that the battery has a 12 ampere-hour rating on it; what is the problem and how can it be solved?

Answer ____

____

b. A neighbor starts to charge his motorcycle battery with an automobile battery charger; what is the problem and how can it be solved?

Answer ____

____

TEST

c. A friend tells you that his motorcycle is down and wants you to give him a jump with your automobile battery; what is the problem and how can it be solved?

Answer ____

____

5. Complete statements concerning battery maintenance by inserting the word(s) that best completes each statement.

   a. When a motorcycle comes in for service, the ____________ level in the battery should always be checked.

   b. The electrolyte level in the battery should be maintained with ____________ water only.

   c. A light coating of grease or petroleum jelly on the battery ____________ will help to reduce corrosion and damage resulting from corrosion, but petroleum jelly should never be put on the battery case.

   d. Terminals and cables can be cleaned with a mixture of ____________ ____________ and ____________, and the battery box can be cleaned with the same solution.

   e. When inspecting a battery, always check for ____________ which will appear as whitish discoloration on the plates inside the battery because it means the battery is bad and you shouldn't waste time trying to charge it.

6. Complete statements concerning hydrometers by inserting the word(s) or figure(s) that best completes each statement.

   a. A hydrometer is a necessity for checking the ____________ ____________ of the electrolyte in a battery cell.

   b. Reading battery voltage with a voltmeter could give an acceptable reading even with one weak or bad cell, but only a hydrometer reading for ____________ ____________ will indicate the condition of each individual cell.

   c. ____________ ____________ readings will not be accurate if they are taken immediately after adding ____________ water to the electrolyte.

   d. A specific gravity reading of ____________ or above indicates a fully charged battery.

   e. A specific gravity reading of less than ____________ indicates that charging is required.

TEST

7. Solve the following problems concerning electrical circuits.

   a. Would a brake light circuit problem also require troubleshooting the accessory circuit, and if it would or wouldn't, explain why?

   Answer ____

   ____

   b. Why it is relatively easy to trace a specific wire when troubleshooting a motorcycle electrical circuit?

   Answer ____

   ____

8. Complete statements concerning systematic electrical troubleshooting by inserting the word(s) that best completes each statement.

   a. Systematic electrical troubleshooting means __________ a problem in as short a time as possible.

   b. Systematic troubleshooting means doing things with procedures that have been proven __________.

   c. Some of the elements of systematic troubleshooting include:

      1) Clearly __________ the customer's complaint

      2) Having the proper wiring __________ available to locate the components in the affected circuit

      3) Knowing the __________ of wires you will be looking for and testing

      4) Knowing the location of __________ and __________ connections where troubles are most likely to occur

      5) Knowing the __________ that wires take so you can physically trace them on the bike

      6) Having the proper __________ equipment to measure electrical activity

   d. By splitting a circuit in __________, the problem can be isolated to the __________ __________ or the __________ __________ of the circuit.

   e. By continuing to split the circuit in __________, you can quickly isolate the trouble area.

TEST

9. Select true statements concerning test light troubleshooting by placing an "X" beside each statement that is true.

_____a. Because a test light requires no adjustment, is almost indestructable, and is suitable for almost all electrical troubleshooting, it is the handiest troubleshooting instrument of all.

_____b. A test light will indicate the presence of voltage and the amount of voltage, and most readings made in electrical troubleshooting require no more than these items.

_____c. A test light can also be used to measure battery voltage, resistance, the output of a charging system or any condition that requires knowing specific voltage or resistance.

_____d. As entry-level technicians gain skills, they will find that it is important to learn to use other more sophisticated test instruments such as VOM or a service tester.

_____e. Entry level technicians who develop good skills with a test light will find learning to use more sophisticated test instruments much easier.

10. Complete statements concerning voltmeter use by inserting the word(s) or figure(s) that best completes each statement.

a. When you need to know the specific voltage in a circuit or circuit component, a _____________ must be used.

b. Although senior technicians use voltmeters and VOM's for sophisticated diagnosis, entry-level technicians mostly use a voltmeter to test _____________ voltage.

c. Testing a battery with voltmeter is a simple procedure:

   1) Set the voltmeter on 10V DC to check a _____________-_____________ system, or on 20V DC to check a _____________-_____________ system.

   2) Place the red probe on the _____________ battery post.

   3) Place the black probe on the _____________ battery post.

   4) Read the results from the proper scale.

d. A standard voltmeter reading with engine off and all lights on should show a minimum of _____________ volts.

e. A standard voltmeter reading with the starter engaged should not drop below _____________ volts.

TEST

11. Select true statements concerning types of splices by placing an "X" beside each statement that is true.

_____a. The two most common splices used around motorcycle wires are the simple straight splice and the tap splice.

_____b. A simple straight splice requires removing about half an inch of insulation from each wire to be spliced and twisting the two wires together.

_____c. A simple splice should be completed by soldering the splice area to insure a permanent connection, and then insulated with shrink tubing or electrical tape.

_____d. A tape splice requires removing about half an inch of insulation from the wire to be tapped into and half an inch of insulation from the end of the tape wire.

_____e. A tap splice should also be completed by wrapping the tap wire around the straight wire, and soldered and insulated.

_____f. Simple splices are used mostly to repair broken wires, and tap splices are used mostly for the addition of accessory lights and other electrical add-ons.

_____g. Before making a tap splice, be certain that the electrical system will support the additional requirements that the accessory will add to the circuit.

(NOTE: If the following activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

12. Trace a motorcycle brake light circuit on a wiring diagram. (Assignment Sheet #1)

13. Demonstrate the ability to:

    a. Service and charge a new motorcycle battery. (Job Sheet #1)

    b. Remove, clean, service, and install a motorcycle battery. (Job Sheet #2)

    c. Check the output of a charging system. (Job Sheet #3)

    d. Use a test light to verify voltage. (Job Sheet #4)

    e. Splice and solder electrical wires. (Job Sheet #5)

BATTERY AND ELECTRICAL SERVICE
UNIT VIII

ANSWERS TO TEST

1. a. 5
   b. 6
   c. 1
   d. 3
   e. 7
   f. 2
   g. 4

2. a. Chemical
   b. 2
   c. 2, 6, 12
   d. 2
   e. Maintain
   f. Starting

3. a, c, d, e, g, h

4. a. A battery should never be charged at more than 10% of its ampere-hour rating, and the charging rate should be dropped down to a maximum of 1.2 amps
   b. Charging a motorcycle battery with an automotive battery charger will ruin the motorcycle battery; use a motorcycle battery charger, or take the battery in for proper charging
   c. Jumping a motorcycle battery with an automobile battery could ruin the motorcycle battery and damage the motorcycle's electrical system; use a proper motorcycle battery charger, or take the battery in for proper service

5. a. Electrolyte
   b. Distilled
   c. Post
   d. Baking soda, water
   e. Sulfation

6. a. Specific gravity
   b. Specific gravity
   c. Specific gravity, distilled
   d. 1.265
   e. 1.2

7. a. No, because all motorcycle circuits are individual and work independently of each other
   b. The wires are color coded

ANSWERS TO TEST

8. a. Isolating
   b. Efficient
   c.
      1) Understanding
      2) Diagram
      3) Colors
      4) Plug-in, soldered
      5) Routes
      6) Test
   d. Half, front half, back half
   e. Half

9. a, d, e

10. a. Voltmeter
    b. Battery
    c.
       1) 6-volt, 12-volt
       2) Positive
       3) Negative
    d. 10.5
    e. 8.5

11. a, b, c, d, e, f, g

12. Evaluated to the satisfaction of the instructor

13. Performance skills evaluated with practical tests

CARBURETORS AND FUEL SYSTEMS

UNIT IX

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify parts of a motorcycle carburetor and discuss the components and operations of various carburetor circuits. The student should also be able to remove, clean, and install a carburetor and remove, clean, and install a fuel valve. These competencies will be evidenced by correctly completing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to carburetors and fuel systems with their correct definitions.
2. Complete statements concerning carburetor operation.
3. Match terms related to the parts of a carburetor with their correct definitions.
4. Select true statements concerning air-fuel ratios.
5. Match carburetor circuits with their general functions.
6. Select true statements concerning float circuit components and operations.
7. Complete statements concerning low-speed circuit components and operations.
8. Complete statements concerning transition circuit components and operations.
9. Select true statements concerning mid-range components and operations.
10. Complete statements concerning high-speed circuit components and operations.
11. Complete statements concerning enrichener circuit components and operations.
12. Complete statements concerning interrelationship of carburetor circuits.

OBJECTIVE SHEET

13. Demonstrate the ability to:

    a. Remove, disassemble, clean, reassemble, and install a one-cylinder motorcycle carburetor. (Job Sheet #1)

    b. Remove, clean, and install a fuel valve. (Job Sheet #2)

CARBURETORS AND FUEL SYSTEMS
UNIT IX

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparency.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Show students a cutaway of a carburetor, if you have one, and use the cutaway to explain the venturi effect and the relationship of components.

H. Explain the necessity for atomizing the air-fuel mixture in the carburetor so that it can be vaporized in the cylinder.

I. Have available a selection of carburetors that students can disassemble and examine.

J. Use video tapes as appropriate for visual reinforcement of objectives and job sheets. S1031—*Carburetion, Part I*; S1033—*Carburetion, Part II*; S1035—*Carburetion, Part III*; S1044—*Idle Mixture Adjustment Procedures*; S1075—*Special Care for Special Carbs*; S1053-CX500—*Principles of Operation*; S1054—*Computerized Fuel Injection, Part I*; S1055—*Computerized Fuel Injection, Part II*; and S1056-CX400—*Failsafe System Diagnosis* are available at educational rates in 1/2" VHS or Beta video tapes from:

American Honda Motors Co., Inc.
Motorcycle VoTech
100 West Alondra Blvd.
Gardena, CA 90248-2702

K. Other video tapes to help reinforce this unit include *Carburetor Basics, Carburetor Circuits*, and *Fuel System Troubleshooting*. These videos are available in 3/4" U-Matic, 1/2" Beta I, 1/2" Beta II, or 1/2" VHS formats from:

Kawasaki Motors Corp., U.S.A.
Service Training
9950 Jeronimo Road
Irvine, CA 92718-2016

L. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics.* New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

C. Johns, Bruce A., and David D. Edmundson. *Motorcycles Fundamentals, Service, Repair.* South Holland, IL: The Goodheart-Willcox Co., Inc., 1984.

D. *Motorcycle Fuel and Induction Systems.* Gardena, CA: American Honda Motor Co., Inc., 1986.

CARBURETORS AND FUEL SYSTEMS
UNIT IX

INFORMATION SHEET

I. **Terms and definitions**

A. Air-fuel ratio — The number of parts of air and number of parts of fuel in an air-fuel mixture, usually expressed in equation form with the amount of air always expressed first

Example: A 12:1 (twelve to one) air-fuel ratio means there are 12 parts of air by weight to 1 part of fuel by weight

B. Atomize — The process by which a carburetor sprays fuel through a fuel jet nozzle into a moving air stream so that the air-fuel mixture is broken down into fine particles

C. Cold start — The temperature of an engine that is below its normal operating range and the absence of heat in the cylinder(s) will not vaporize fuel

D. Lean — An air-fuel mixture that contains more than a normal amount of air

E. Rich — An air-fuel mixture that contains more than a normal amount of fuel

F. Vaporize — The process by which a fine-spray air-fuel mixture is turned into a gaseous form in a combustion chamber so it will ignite instantly when exposed to a spark

II. **Carburetor operation**

A. A motorcycle carburetor works because it takes advantage of some basic laws of physics that relate to atmospheric pressure and the movement of air through a tube.

B. Each time a piston moves down on an intake stroke, it creates a vacuum in the cylinder, and air under atmospheric pressure rushes through the carburetor bore to fill that vacuum.

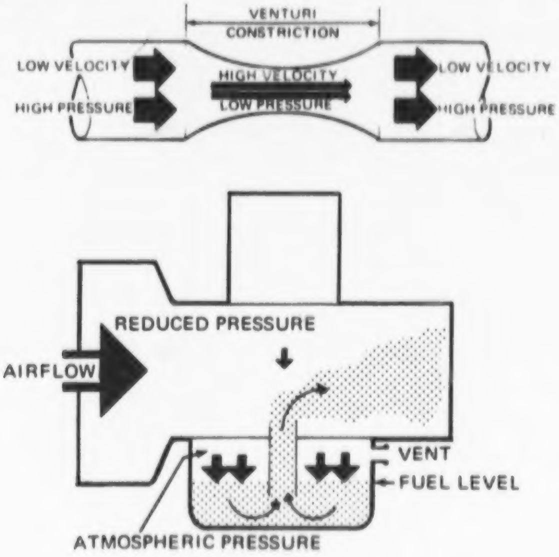
C. The carburetor bore has a narrow or restricted part called the "venturi," and as air passes through the venturi it speeds up because of a phenomenon known as the "venturi effect."

D. Air rushing through the venturi causes the atmospheric pressure around the venturi to lessen.

INFORMATION SHEET

E. The fuel jet nozzle is placed into the venturi at about mid-point so that it will be positioned along the low pressure area of the bore. (Figure 1)

FIGURE 1


VENTURI CONSTRICTION
LOW VELOCITY
HIGH PRESSURE
HIGH VELOCITY
LOW PRESSURE
LOW VELOCITY
HIGH PRESSURE
REDUCED PRESSURE
AIRFLOW
VENT
FUEL LEVEL
ATMOSPHERIC PRESSURE

Courtesy Kawasaki Motors Corp., U.S.A.

F. With the decreased pressure against the fuel jet nozzle, atmospheric pressure in the float bowl forces fuel through the jet nozzle.

G. The jet nozzle sprays the fuel into the fast moving air stream and the air-fuel mixture is atomized as it is carried on to the engine cylinder.

H. In the cylinder, the air-fuel mixture is vaporized in the combustion chamber so it will ignite and burn rapidly.

I. A carburetor is a device that restricts and regulates; it restricts and regulates air with the throttle slide and it restricts and regulates fuel with different sizes of jets.

INFORMATION SHEET

III. **Parts of a carburetor** (Transparency 1)

A. Carburetor body — Houses a fixed venturi and all other parts of the carburetor

B. Jet needle — Controls the amount of fuel from about ¼ to ¾ throttle opening

C. Needle jet — Houses the jet needle, has air bleed holes to mix small amounts of air with the fuel to atomize it, and serves as the main fuel passage in the carburetor

D. Throttle slide — Houses the jet needle, regulates the amount of air passing through the venturi, and has a cutaway section to help meter fuel in the transition circuit

E. Main jet — Regulates the amount of fuel in the main fuel circuit from ¾ throttle to full open throttle

F. Pilot jet — Regulates the amount of fuel in the low speed circuit from zero throttle to ⅛ throttle, and has some effect on the entire operating range of the carburetor

G. Air screw — If it is on the intake side of the carburetor, it regulates air only in the low speed circuit, and if it is on the engine side of the carburetor, it regulates a premixed amount of fuel and air.

H. Throttle stop screw — Regulates the idle speed

I. Float valve assembly — A valve that works with the float to regulate the fuel level in the float chamber

J. Float — Floats on the gas in the float chamber and controls the float needle to permit gas to enter the float as the engine demands

K. Float chamber — A bowl that serves as a reservoir for fuel coming from the fuel line

IV. **Air-fuel ratios**

A. The amount of air mixed with a given quantity of fuel determines the limits of combustion in an engine and controls overall performance.

(NOTE: Performance will vary at higher elevations because of the lower percentage of oxygen in the air.)

B. An air-fuel ratio of 14.7 parts of air to 1 part of gasoline is considered the perfect mixture, but operating conditions are always less than perfect and a ratio of 12:1 actually delivers more power.

INFORMATION SHEET

C. An air-fuel mixture that is too rich will burn poorly, increase fuel consumption, produce excessive hydrocarbons and carbon monoxide, and cause spark plug fouling.

D. An air-fuel ratio that is too lean will burn poorly because the fuel particles are too far apart, and the ratio can cause surging at low speeds and engine overheating.

E. Because a cold engine reduces vaporization, cold starting requires a rich air-fuel ratio and this is usually provided with a manually operated choke or a fuel enrichener.

F. Air-fuel ratios are controlled by carburetor circuits designed specifically for the different operating ranges of the engine.

V. **Carburetor circuits and their general functions** (Transparency 2)

A. Float circuit — Maintains a specific fuel level in the float chamber at all times

B. Low-speed circuit — Meters the air-fuel mixture at idle and at small throttle openings (sometimes called the idle circuit)

C. Transition circuit — Regulates the air-fuel ratio as the carburetor moves from the low-speed circuit to the mid-range circuit

D. Mid-range circuit — A combination of circuits which work together to maintain the correct air-fuel ratio between 1/4 throttle and 3/4 throttle

E. High-speed circuit — Controlled by the main jet and regulates the air-fuel ratio from 3/4 throttle to full open throttle

F. Enrichener circuit (or choke) — Controlled by an additional starting circuit to provide an extremely rich mixture for cold starting

VI. **Float circuit components and operations**

A. The major components of the float circuit are the fuel bowl, float valve and seat assembly, and the float(s).

B. The fuel level in the fuel bowl must be high enough so that the main pilot and starter circuits extend into the fuel supply so there will be a constant supply of fuel.

C. The fuel level affects how rich or lean the engine will run.

INFORMATION SHEET

D. If the fuel level is too low, the vacuum in the venturi will not be strong enough to pull sufficient fuel out of the bowl into the air stream, and a lean mixture will result.

E. If the fuel level is too high, the vacuum in the venturi will have to lift the fuel a shorter distance and a rich mixture will result.

F. To measure the fuel level, the engine must be running, but since this is not always possible, the float level is measured instead, and the measurement is made from the bottom of the float to the carburetor body gasket surface using a special float gauge.

G. Adjusting the float level is accomplished by bending the float arms or a tab that will raise or lower the fuel level.

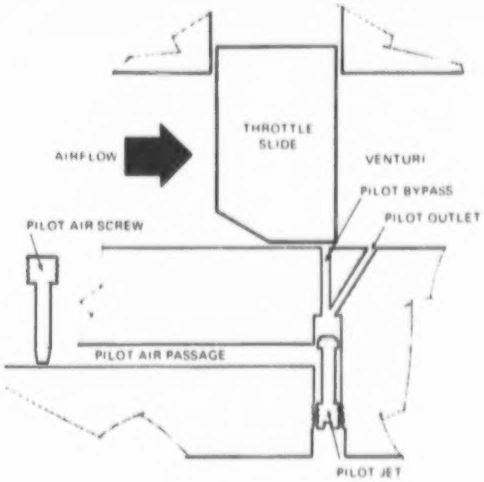
H. The float level must always be set to the manufacturer's recommended setting.

VII. **Low-speed circuit components and operations** (Transparency 2)

A. The low-speed or pilot circuit is a series of passages in the carburetor body.

B. The pilot jet meters fuel and a pilot screw meters air to provide a correct air-fuel ratio during idle. (Figure 2)

FIGURE 2



Courtesy Kawasaki Motors Corp., U.S.A.

INFORMATION SHEET

C. Sometimes the metering for idle is controlled by an air jet and a pilot jet, and the air-fuel ratio is predetermined by the size of the jets.

D. In the two-jet system, the amount of air-fuel mixture is regulated by the pilot screw.

E. Air for the pilot circuit enters through a small passage in the inlet side of the venturi, is mixed with a small amount of fuel from the fuel chamber, and enters the air stream on the engine side as an atomized air-fuel mixture.

F. Some pilot jets have small air bleed holes to allow air to mix with fuel and partially atomize the mixture in the carburetor body before it reaches the venturi.

VIII. **Transition circuit components and operations** (Transparency 2)

A. The transition circuit is controlled primarily by the amount of cutaway on the bottom of the throttle slide.

(NOTE: On models with accelerator pumps, the transition circuit is controlled by the length of the accelerator pump stroke.)

B. The cutaway functions like the restriction in a venturi and causes air to accelerate and form a vacuum that draws small amounts of fuel from both the low-speed and mid-range circuits.

C. As the height of the cutaway increases, the air-fuel ratio becomes leaner; as the height of the cutaway decreases, the air-fuel ratio becomes richer.

D. Throttle slides are available with different degrees of cutaway to permit carburetor adjustments in the 1/8 throttle to 1/4 throttle range.

IX. **Mid-range circuit components and operations** (Transparency 2)

A. The mid-range circuit is a combination circuit that draws from both the low-speed circuit and the transition circuit, but the jet needle and needle jet are the primary controllers of the mid-range circuit.

B. The tapered jet needle is attached to the throttle slide and points downward through the center of the carburetor venturi.

C. The tapered end of the jet needle fits into the needle jet which is located in the carburetor body.

INFORMATION SHEET

D. The air flow is controlled by the slide and the fuel flow is controlled by the clearance between the jet needle and the needle jet.

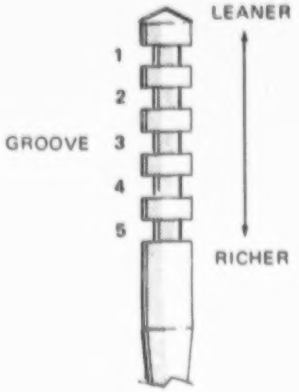
E. As the slide is raised, it raises the jet needle out of the needle jet and creates a greater clearance between the jet needle and the needle jet and allows more fuel to flow from ¼ to ¾ throttle.

F. There are usually five grooves in the top of the jet needle that permit adjustment of the most important part of the mid-range circuit.

(NOTE: New models cannot be adjusted because of new EPA regulations.)

G. Lowering the clip raises the jet needle and the air-fuel ratio becomes richer while raising the clip lowers the needle and the air-fuel ratio becomes leaner. (Figure 3)

FIGURE 3



Courtesy Kawasaki Motors Corp., U.S.A.

H. Jet needles are available with different degrees of taper, and needle jets are available in different sizes to allow for fine tuning.

X. **High-speed circuit components and operations**

A. The main jet is the primary component of the high-speed circuit and is located in the fuel passage between the float chamber and the needle jet.

B. All fuel flowing through the needle jet must flow through the main jet.

INFORMATION SHEET

C. At approximately ¾ throttle opening, the clearance between the needle jet and jet needle becomes greater than the size of the hole in the main jet.

D. The main jet meters fuel flow from ¾ throttle to full open.

XI. **Enrichener circuit components and operations**

A. Since a cold engine does not contain enough heat to vaporize droplets of fuel in an ordinary air-fuel mixture, the carburetor needs to feed a richer mixture to the engine for cold starting.

B. The enrichener circuit is sometimes a cold-start circuit or simply a choke, and is a special fuel circuit dedicated to making the engine easy to start when it is cold or hasn't recently been started.

C. A choke restricts the amount of air that can enter the carburetor and causes a high vacuum which pulls an additional quantity of fuel out of the fuel bowl to provide a mixture rich enough to start the engine.

D. Another type of cold starting system is called the enrichener or starter circuit.

E. The enrichener circuits consist of:

1. A starter jet to meter the fuel
2. A plunger which opens an air passage from the inlet of the carburetor, around the slide, so that incoming air re-enters on the engine side of the slide

F. With the plunger lifted, air rushes through the passage and causes a venturi effect which causes an additional amount of fuel to flow through the starter jet and into the engine.

G. The throttle slide must be closed for the enrichener circuit to operate, and the plunger must be manually lifted from its seat.

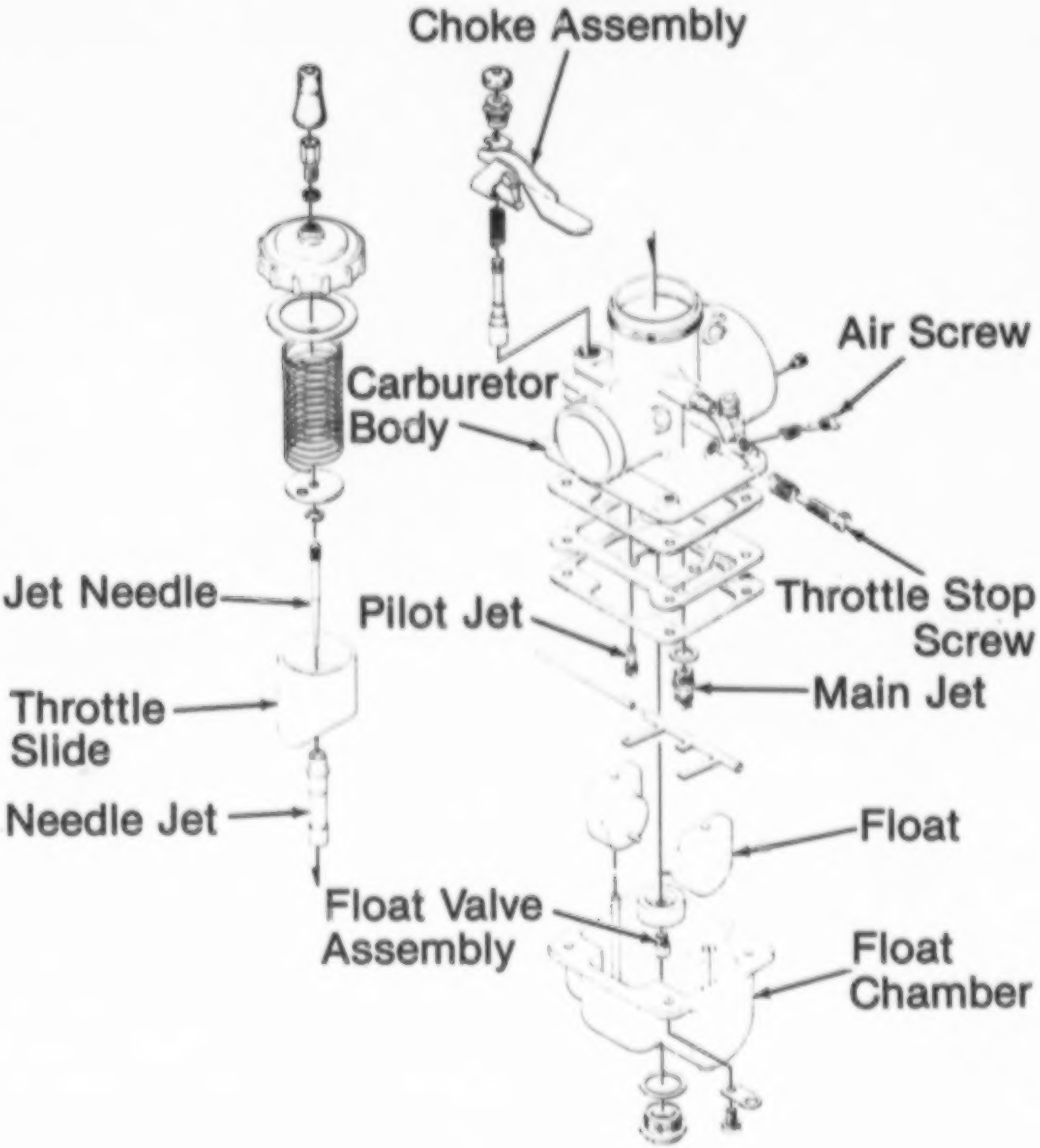
INFORMATION SHEET

XII. **Interrelationship of carburetor circuits** (Transparency 2)

A. Although it is easier to understand fuel circuit functions by talking about each circuit individually, no one circuit totally controls carburetor operation at any one time.

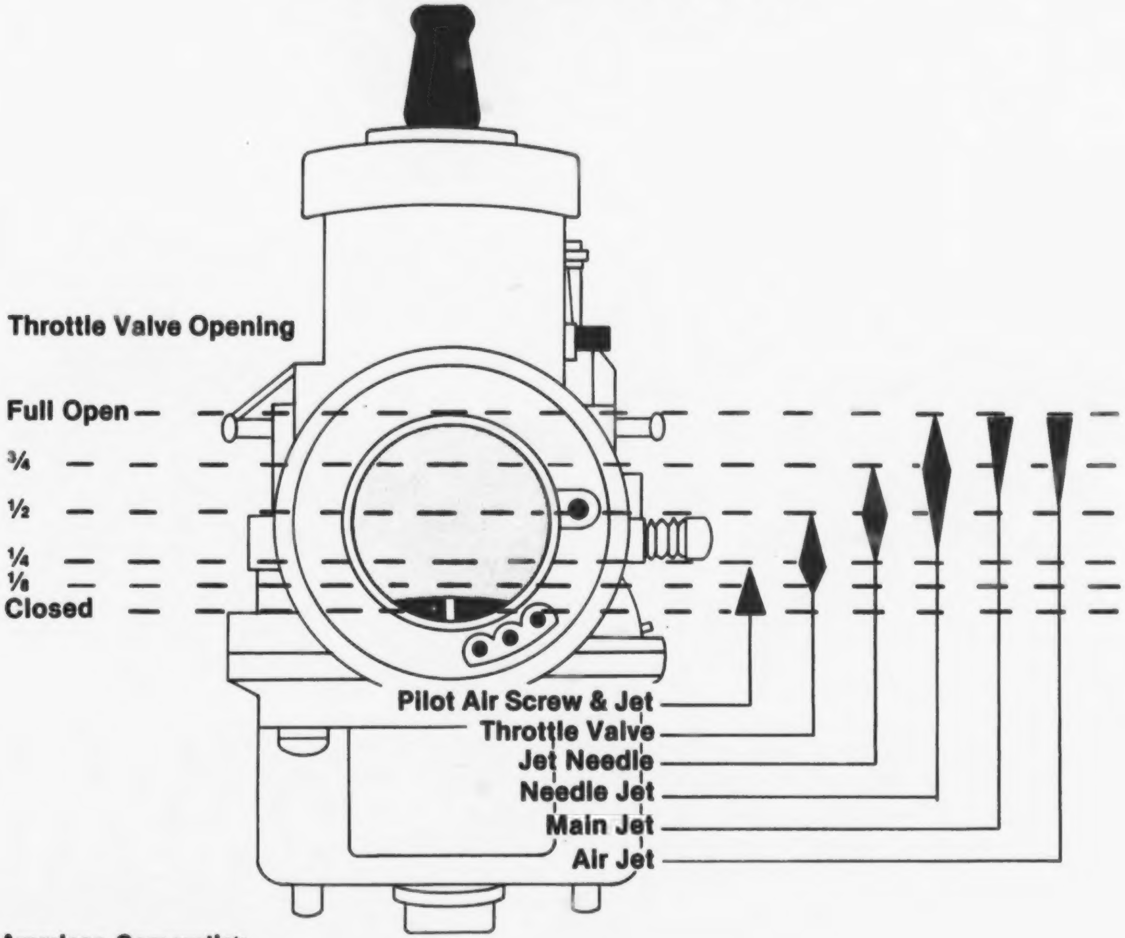
B. Respecting the carburetor as a single functioning system is important when considering a jetting change.

Parts of a Carburetor


Choke Assembly
Air Screw
Carburetor Body
Jet Needle
Pilot Jet
Throttle Stop Screw
Main Jet
Throttle Slide
Needle Jet
Float
Float Valve Assembly
Float Chamber

Courtesy Mikuni American Corporation.

Carburetor Circuits


Throttle Valve Opening
Full Open
¾
½
¼
⅛
Closed
Pilot Air Screw & Jet
Throttle Valve
Jet Needle
Needle Jet
Main Jet
Air Jet

Courtesy Mikuni American Corporation.

CARBURETORS AND FUEL SYSTEMS
UNIT IX

JOB SHEET #1 — REMOVE, DISASSEMBLE, CLEAN, REASSEMBLE, AND INSTALL A ONE-CYLINDER MOTORCYCLE CARBURETOR

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Carburetor cleaner
6. Float level gauge
7. Compressed air supply
8. 1/4" drill with 1/8" bit
9. New limiter cap or pilot screw plug
10. Drain pan
11. Safety glasses and face shield

B. Routine #1 — Removing the carburetor

1. Put on safety glasses.
2. Secure the motorcycle in an upright position.
3. Disconnect the negative battery cable and secure it.
4. Turn the gas valve off, disconnect the fuel line, remove the gas tank, and set it aside in a safe place.

JOB SHEET #1

5. Loosen the float chamber drain screw and drain all gas out of the carburetor into a drain pan. (Figure 1)

FIGURE 1

6. Loosen the clamp on the air filter boot and remove the air filter boot from the carburetor. (Figure 2)

FIGURE 2

JOB SHEET #1

7. Remove the throttle slide from the carburetor. (Figure 3)

   (NOTE: Sometimes the throttle cable is attached externally and sometimes internally, so you may need to remove the top of the carburetor to remove the throttle cable.)

FIGURE 3

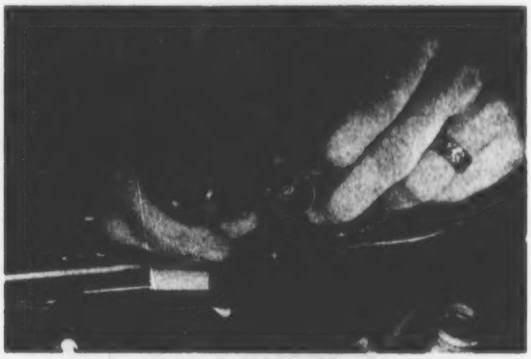
8. Pull the throttle slide and jet needle out of the top of the carburetor. (Figure 4)

FIGURE 4

JOB SHEET #1

9. Pull the throttle slide return spring up toward the carburetor top and reach in with a small screwdriver and remove the retaining clip from the throttle slide. (Figure 5)

FIGURE 5



10. Disengage the throttle cable end and remove the throttle slide from the cable.

11. Remove the carburetor top and spring from the cable and set all the parts aside for cleaning and inspection. (Figure 6)

FIGURE 6

12. Remove the choke if there is one.

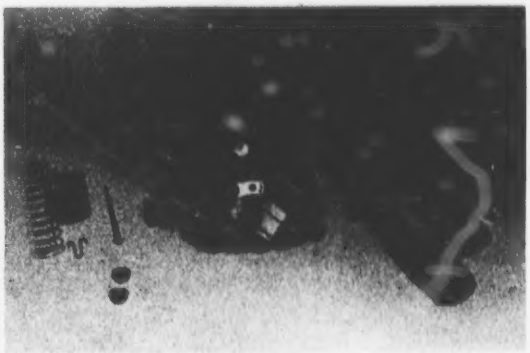
13. Loosen the clamp or remove the nuts or bolts from the carburetor flange.

14. Remove the carburetor and drain any fuel left in it into a drain pan.

JOB SHEET #1

15. Set the carburetor body aside for disassembly, cleaning, and inspection. (Figure 7)

FIGURE 7



☐ Have your instructor check your work.

16. Clean up any gas that spilled as you removed the carburetor.

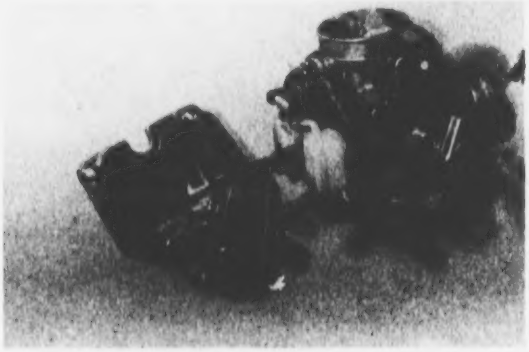
C. Routine #2 — Disassembling the carburetor

1. Leave your safety glasses on.

2. Remove the float chamber attaching screws and remove the float chamber from the carburetor. (Figure 8)

(NOTE: Make a sketch of where the float chamber hose guides come from so you can put them back in the right places.)

FIGURE 8

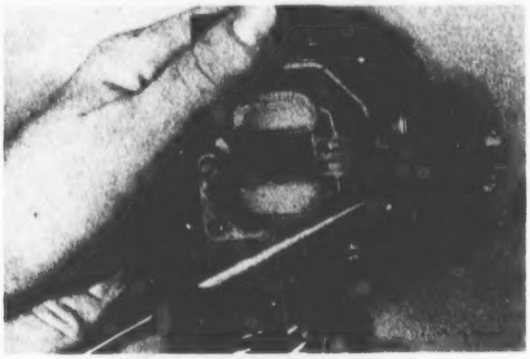


JOB SHEET #1

3. Use a pair of needlenose pliers to remove the float pin, and be sure it comes out from the correct side and in the right direction. (Figure 9)

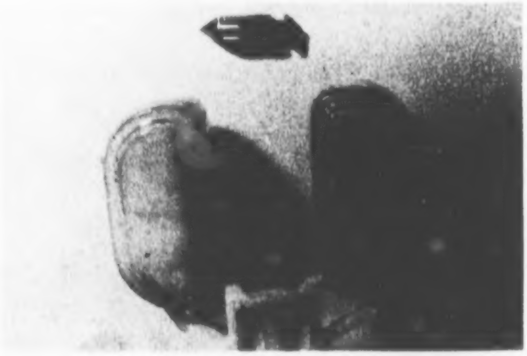
   (NOTE: If the pin is stuck, a punch can be used to free it, but proper support of the mounting boss is absolutely required, so if you can't get the pin out freely, ask your instructor for assistance.)

   FIGURE 9



4. Remove the float and float valve and set them aside. (Figure 10)

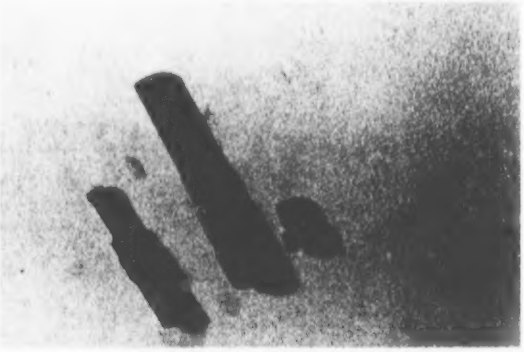
   FIGURE 10



JOB SHEET #1

5. Remove the main jet, main jet holder, needle jet, baffle, and slow jet and set them aside. (Figure 11)

FIGURE 11

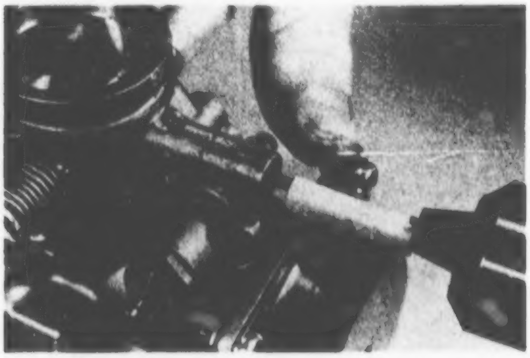


6. Remove the limiter cap or the air screw plug with the following procedure:

   a. If you're working on an air screw plug, you have to drill through the plug so you can place a screw in it to pull it out.

   b. Use your 1/8" bit, but put a limiting collar on the bit so the depth you drill will be limited and you won't drill into the air screw. (Figure 12)

FIGURE 12



JOB SHEET #1

c. Screw a self-tapping metal screw into the hole in the plug, and then use a pair of pliers to pull the screw out and the plug will come with it. (Figure 13)

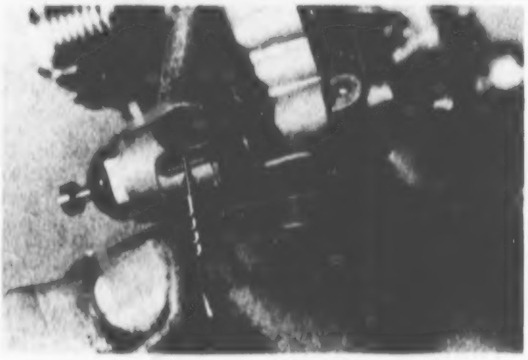
FIGURE 13

d. Lightly seat the air screw and count the turns so you'll be able to make an initial adjustment when you reassemble the carburetor. (Figure 14)

FIGURE 14

e. Remove the air screw completely from the carburetor. (Figure 15)

FIGURE 15



JOB SHEET #1

f. If you're working with a limiter cap, and you have removed the float chamber, chances are you will not have to remove the limiter cap to take the air screw out.

g. If you do have to remove the limiter cap, use a pair of pliers and pull the cap straight off carefully.

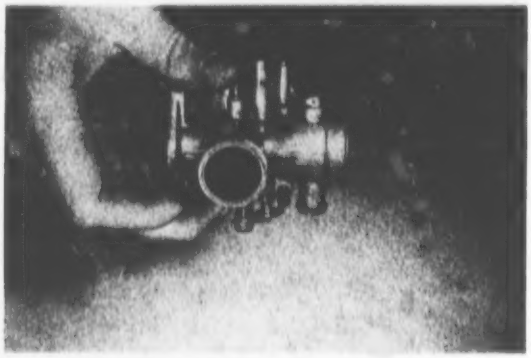
h. If you break the air screw while attempting to remove the limiter cap, you will have to replace both the air screw and the cap.

i. When you get the limiter cap off, turn the air screw in until it is lightly seated, and count the turns so you'll be able to make an initial adjustment when you reassemble the carburetor.

j. Remove the air screw completely from the carburetor.

7. Remove the throttle stop screw and set it aside with the air screw. (Figure 16)

FIGURE 16



8. Unscrew the lock nut and remove the starter valve or enrichener.

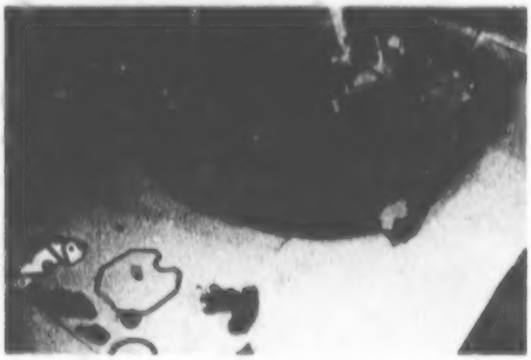
9. Remove all O-rings that are on the air screw and enrichener valve, and remove the gasket or O-ring from the mounting flange.

JOB SHEET #1

10. Place all metal parts and screws into a carburetor cleaner basket. (Figure 17)

    (CAUTION: Do not put O-rings or rubber parts into carburetor cleaner because the cleaner will destroy them.)

    FIGURE 17

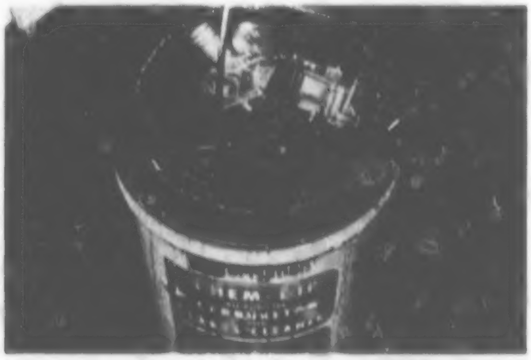


☐ Have your instructor check your work.

D. Routine #3 — Cleaning and inspecting carburetor parts

1. Leave your safety glasses on.
2. Place the basket of parts slowly into the carburetor cleaner to keep cleaner from splashing out. (Figure 18)

    FIGURE 18

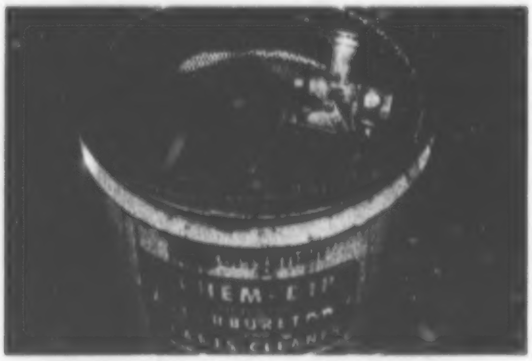


3. Leave parts in the cleaner for fifteen to thirty minutes as specified on the cleaner directions.
4. Use your time to good advantage while you're waiting for the parts to be cleaned by cleaning all gasket surfaces, and inspecting the throttle and choke cables.

JOB SHEET #1

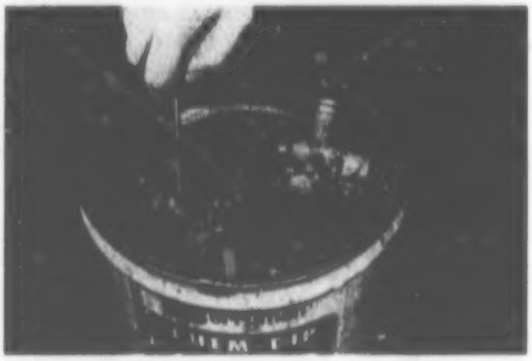
5. Remove the carburetor basket from the cleaner, hook it over the side of the cleaning station, and permit it to drain. (Figure 19)

FIGURE 19



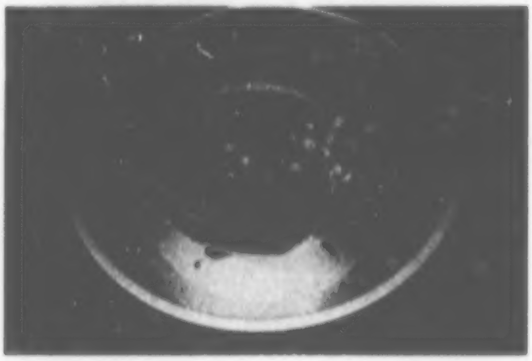
6. Move the parts around with a screwdriver to make sure all the carburetor cleaner drains back into the tank. (Figure 20)

FIGURE 20



7. Place the carburetor cleaning basket in a large drain pan and take it to the sink. (Figure 21)

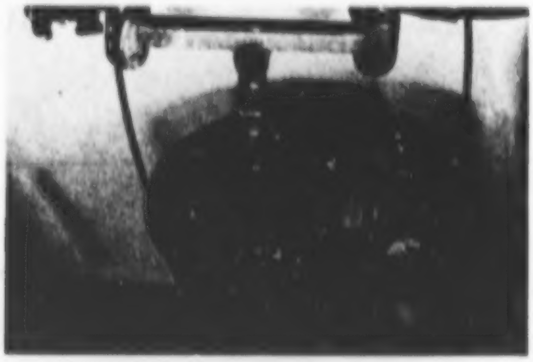
FIGURE 21



JOB SHEET #1

8. Rinse all parts thoroughly in cold water. (Figure 22)

FIGURE 22



9. Take the parts back to the disassembly area and blow out all passages and thoroughly dry all parts with compressed air. (Figure 23)

(CAUTION: Small springs and screws are easy to lose when drying them with compressed air, so use care, and beware of carburetor cleaner residue that may remain on parts.)

FIGURE 23

JOB SHEET #1

10. Lay the parts out on a clean shop towel as you dry them so they'll be ready for inspection. (Figure 24)

FIGURE 24

11. Hold all jets up to the light and look through them to make sure the jet passage is unobstructed. (Figure 25)

FIGURE 25

12. Clean obstructed jet passages with compressed air or an aerosol contact cleaner, but do not clean the jet with a wire or drill bit. (Figure 26)

FIGURE 26

JOB SHEET #1

13. Replace any obstructed jets that cannot be cleaned with new ones.

14. Inspect the float needle for damage or wear which will appear as a circle that is worn around the seating surface of the needle. (Figure 27)

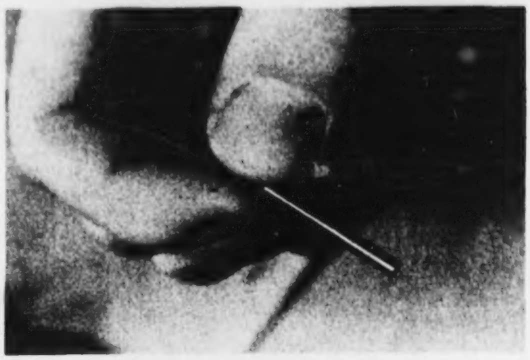
FIGURE 27

15. Replace the needle and needle seat if the needle is worn.

16. Inspect the float pin for wear which will appear on the pin where the float works up and down the pin, and usually in the middle of the pin. (Figure 28)

(NOTE: A slight circle indicating normal wear is acceptable.)

FIGURE 28

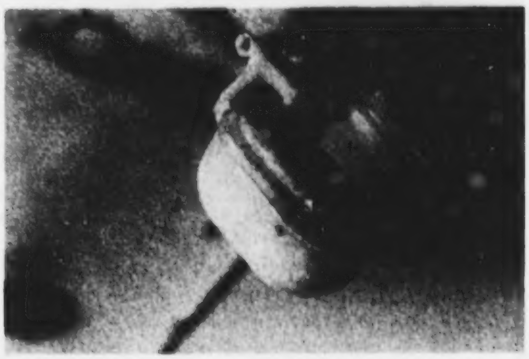


17. Replace the float pin if the old one is worn.

JOB SHEET #1

18. Inspect the float to make sure it hasn't collapsed, that it is securely soldered to the flat arms, and that there is no evident damage. (Figure 29)

FIGURE 29

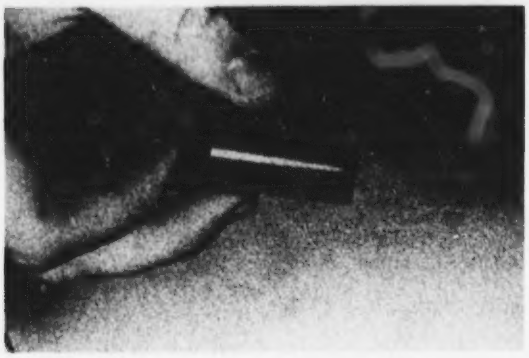


19. Shake the float close to your ear and listen for the presence of any fuel in the float.

20. Replace the float if the old one is bad.

21. Inspect the throttle slide for wear that usually appears as deep scratches or gouges. (Figure 30)

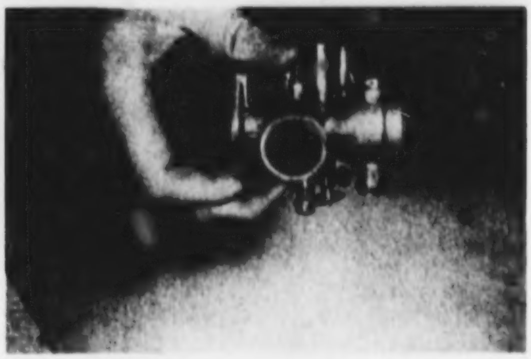
FIGURE 30



JOB SHEET #1

22. Look down the throttle slide bore in the body of the carburetor, check for wear, and make sure the throttle slide guide pin is not worn or damaged. (Figure 31)

FIGURE 31



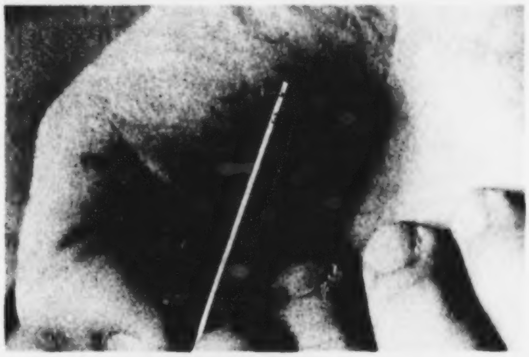
23. Install the throttle slide into the carburetor body and make sure it slides freely.

24. Replace the throttle slide as required, but if the guide pin is damaged or missing the entire carburetor will have to be replaced.

(NOTE: A new guide pin can be made from a proper size pin, but it's a job for an experienced technician.)

25. Inspect the jet needle for straightness and for wear which will appear along the body and at the point where the jet needle clip fits over it. (Figure 32)

FIGURE 32



26. Inspect the jet needle clip to make sure it fits snugly in the appropriate groove on the jet needle.

27. Replace jet needle or clip as required.

JOB SHEET #1

28. Check the float bowl for damage caused by corrosion, and if the low speed jet is a part of the float bowl, squirt some contact cleaner through it to make sure it is open.

29. Clean the low speed jet with compressed air or otherwise replace the float bowl as required.

☐ Have your instructor check your work.

E. Routine #4 — Reassembling and initially adjusting the carburetor

1. Put your safety glasses on.

2. Install the float needle seat.

3. Install the starter valve or enrichener.

4. Install the main jet holder, needle jet, baffle, main jet, and slow jet in proper sequence and in their proper places.

   (NOTE: Do not overtighten these parts because they twist off easily, but be sure they are well seated.)

5. Install the air screw, turn it in until it is lightly seated, and then turn it out the same number of turns noted at disassembly

6. Install the throttle stop screw, turn it in until it is lightly seated, and then turn it out the same number of turns noted at disassembly — but screw it out one extra full turn.

   (NOTE: The extra full turn will help prevent the possibility of over revving the engine at start up.)

7. Install the float needle and the float, and you will probably have to install them as an assembly because there may be a small wire clip that fastens them together.

8. Install the float pin.

9. Check the float level with a float level gauge or caliper and adjust to the specifications in the service manual.

   (NOTE: Float level adjustment varies from model to model and it's important to follow the specific procedure.)

10. Install the gasket or O-ring on the float bowl and install the float bowl.

11. Install the float chamber hose guides and float chamber screws, and snug the screws down lightly before tightening, but don't damage the fuel bowl by overtightening the screws.

JOB SHEET #1

12. Install the jet needle clip in its original groove.

13. Install the jet needle into the carburetor slide valve.

14. Install the throttle cable into the carburetor top.

15. Install the spring into the carburetor top and compress it with your hand so you can engage the throttle cable end into the throttle valve.

16. Install the retaining clip and let the spring go to allow it to seat into the throttle slide.

17. Check to make sure that the cutaway at the bottom of the throttle slide faces the air cleaner side of the carburetor.

18. Push the throttle slide down into the bore.

    (CAUTION: Make certain that the slide is installed in the correct position so that the groove along the throttle slide engages the guide pin in the throttle slide bore.)

19. Put the carburetor top back on, make sure it is straight, and screw it on carefully because it's very easy to cross thread and ruin the carburetor.

20. Look into the bore of the carburetor as you turn the throttle to make certain that the throttle slide operates smoothly and does not stick or bind.

☐ Have your instructor check your work.

F. Routine #5 — Installing and adjusting the carburetor

1. Leave your safety glasses on.

2. Look inside the carburetor flange and inside the air boot to make sure they are both free of dirt, pieces of old gasket, or foreign matter of any kind.

3. Replace the carburetor on the motorcycle, taking care not to damage any rubber flanges, O-rings, or gaskets.

4. Check to make sure gaskets or rubber flanges are fitting properly onto the carburetor as you snug down the clamps or bolts.

   (NOTE: Do not tighten up one side of the carburetor and then the other or it will damage the carburetor; rather, snug all the bolts down first and then use an alternating sequence to tighten, but not overtighten, the bolts.)

5. Work the throttle to make sure it isn't sticking or binding.

JOB SHEET #1

6. Check all mating surfaces to be sure they are seated properly on rubber flanges or gaskets.

7. Check the back side of the air boot to make sure it has not been displaced from the air box.

☐ Have your instructor check your work.

8. Install the gas tank and fuel line.

9. Turn the fuel on.

10. Put the negative cable back on the battery.

11. Check with your instructor to see if you are to start the motorcycle so you can make final adjustments on the carburetor.

12. Start the engine and let it warm up to operating temperature.

13. Adjust the idle speed with the idle stop screw to about 1,200 rpm or to specifications.

14. Continue final adjustment as outlined in the service manual until carburetor is properly adjusted.

(CAUTION: If you have to run the engine for a prolonged period, use a fan.)

☐ Have your instructor check your work.

15. Shut off the engine.

16. Replace the pilot screw plug with a new one, or replace the limiter cap.

17. Clean up area and return tools and materials to proper storage.

CARBURETORS AND FUEL SYSTEMS
UNIT IX

JOB SHEET #2 — REMOVE, CLEAN, AND INSTALL A FUEL VALVE

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Compressed air supply
6. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Check the area to make sure it is free of combustible materials and that there is a fire extinguisher nearby.
3. Open the fuel valve and drain all of the gasoline out of the tank into a large drain pan.
4. Dispose of the old gasoline according to the safe procedure outlined by your instructor.

   (NOTE: If fuel will not flow through the fuel valve, the tank will have to be removed and the gasoline will have to be poured out through the filler cap.)

5. Place the gas tank, if you had to remove it, onto a padded surface so it won't get scratched or damaged while you are working on the fuel valve.

JOB SHEET #2

6. Remove the fuel valve from the tank. (Figure 1)

FIGURE 1

7. Remove the fuel strainer from the inlet end of the fuel valve. (Figure 2)

FIGURE 2

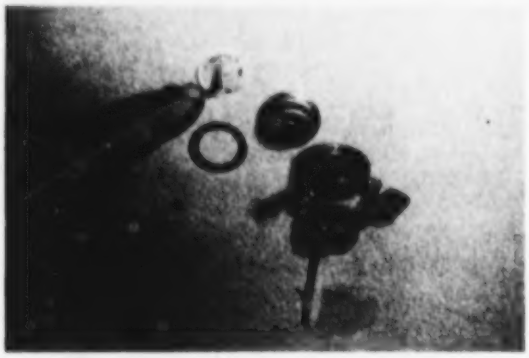
8. Clean the fuel strainer with compressed air, blowing from the inside out. (Figure 3)

FIGURE 3

JOB SHEET #2

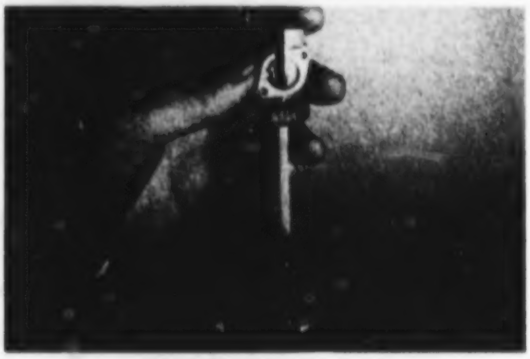
9. Remove the sediment bowl, if there is one, and remove the strainer and O-ring, and clean the strainer with compressed air. (Figure 4)

FIGURE 4



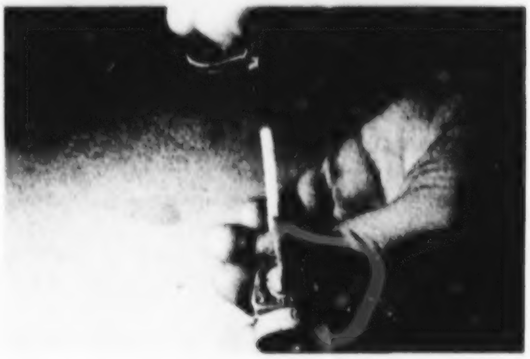
10. Put the fuel valve in the ON position and blow compressed air through the fuel valve from the inlet side. (Figure 5)

FIGURE 5



11. Put the fuel valve in the RESERVE position and blow compressed air through the valve from the inlet side. (Figure 6)

FIGURE 6



JOB SHEET #2

12. Inspect the O-ring on the sediment bowl strainer and replace as required. (Figure 7)

FIGURE 7

13. Replace the strainer and O-ring on the sediment bowl.

14. Replace the strainer on the inlet side of the fuel valve.

15. Inspect the gasket or O-ring that helps seal the fuel valve to the fuel tank and if there is any flattening, replace as required. (Figure 8)

FIGURE 8

16. Position the fuel valve in the proper location and reinstall it onto the fuel tank being careful not to overtighten it.

17. Install the gas tank on the motorcycle.

18. Put an adequate amount of fuel in the gas tank.

19. Put a drain pan under the valve, turn the valve to the ON position, and make sure there is a free flow of gasoline through the valve.

20. Repeat the same procedure with the valve in the RESERVE position.

21. Reconnect the fuel valve to the fuel line.

JOB SHEET #2

☐ Have your instructor check your work.

22. Clean up area and return tools and equipment to proper storage.

CARBURETORS AND FUEL SYSTEMS
UNIT IX

PRACTICAL TEST #1
JOB SHEET #1 — REMOVE, DISASSEMBLE, CLEAN, REASSEMBLE, AND INSTALL A ONE-CYLINDER MOTORCYCLE CARBURETOR

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed carburetor with proper procedure.	2.	☐	☐
3. Disassembled carburetor for cleaning.	3.	☐	☐
4. Cleaned and dried carburetor parts properly.	4.	☐	☐
5. Inspected parts.	5.	☐	☐
6. Made careful check of all jets.	6.	☐	☐
7. Reassembled carburetor properly.	7.	☐	☐
8. Replaced carburetor on vehicle.	8.	☐	☐
9. Made initial carburetor adjustments.	9.	☐	☐
10. Cleaned area and returned tools to storage.	10.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CARBURETORS AND FUEL SYSTEMS
UNIT IX

PRACTICAL TEST #2
JOB SHEET #2 — REMOVE, CLEAN, AND INSTALL A FUEL VALVE

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Drained fuel tank and removed fuel valve.	2.	☐	☐
3. Cleaned fuel strainer and sediment bowl.	3.	☐	☐
4. Checked fuel valve in ON and RESERVE positions.	4.	☐	☐
5. Reassembled valve, strainer, and bowl.	5.	☐	☐
6. Replaced valve on vehicle.	6.	☐	☐
7. Filled gas tank and checked valve.	7.	☐	☐
8. Cleaned area and returned tools to storage.	8.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CARBURETORS AND FUEL SYSTEMS
UNIT IX

NAME ______________________

TEST

1. Match terms related to carburetors and fuel systems with their correct definitions.

______a. The number of parts of air and number of parts of fuel in an air-fuel mixture, usually expressed in equation form with the amount of air always expressed first

______b. The process by which a carburetor sprays fuel through a fuel jet nozzle into a moving air stream so that the air-fuel mixture is broken down into fine particles

______c. The temperature of an engine that is below its normal operating range and the absence of heat in the cylinder(s) will not vaporize fuel

______d. An air-fuel mixture that contains more than a normal amount of air

______e. An air-fuel mixture that contains more than a normal amount of fuel

______f. The process by which a fine-spray air-fuel mixture is turned into a gaseous form in a combustion chamber so it will ignite instantly when exposed to a spark

1. Lean
2. Cold start
3. Vaporize
4. Air-fuel ratio
5. Atomize
6. Rich

2. Complete statements concerning carburetor operation by inserting the word(s) that best completes each statement.

a. A motorcycle carburetor works because it takes advantage of some basic laws of physics that relate to ____________ ____________ and the movement of ____________ through a tube.

b. Each time a piston moves down on an intake stroke, it creates a ____________ in the cylinder, and air under atmospheric pressure rushes through the carburetor bore to fill that ____________.

c. The carburetor bore has a narrow or restricted part called the ____________, and as air passes through the ____________ it speeds up because of a phenomenon known as the ____________ ____________.

TEST

d. Air rushing through the venturi causes the atmospheric pressure around the venturi to ____________.

e. The ____________ ____________ ____________ is placed into the venturi at about mid-point so that it will be positioned along the low pressure area of the bore.

f. With the decreased pressure against the fuel jet nozzle, ____________ ____________ in the float bowl forces fuel through the jet nozzle.

g. The jet nozzle sprays the fuel into the fast moving air stream and the air-fuel mixture is ____________ as it is carried on to the engine cylinder.

h. In the ____________, the air-fuel mixture is vaporized in the combustion chamber so it will ignite and burn rapidly.

i. A carburetor is a device that restricts and regulates; it restricts and regulates ____________ with the throttle slide and it restricts and regulates ____________ with different sizes of jets.

3. Match terms related to the parts of a carburetor with their correct definitions.

_____a. Houses a fixed venturi and all other parts of the carburetor

_____b. Controls the amount of fuel from about 1/4 to 3/4 throttle opening

_____c. Houses the jet needle, has air bleed holes to mix small amounts of air with the fuel to atomize it, and serves as the main fuel passage in the carburetor

_____d. Houses the jet needle, regulates the amount of air passing through the venturi, and has a cutaway section to help meter fuel in the transition circuit

_____e. Regulates the amount of fuel in the main fuel circuit from 3/4 throttle to full open throttle

_____f. Regulates the amount of fuel in the low speed circuit from zero throttle to 1/8 throttle, and has some effect on the entire operating range of the carburetor

1. Pilot jet
2. Float
3. Throttle slide
4. Needle jet
5. Air screw
6. Float chamber
7. Carburetor body
8. Throttle top screw
9. Float valve assembly
10. Jet needle
11. Main jet

TEST

_____g. If it is on the intake side of the carburetor, it regulates air only in the low speed circuit, and if it is on the engine side of the carburetor, it regulates a premixed amount of fuel and air.

_____h. Regulates the idle speed

_____i. A valve that works with the float to regulate the fuel level in the float chamber

_____j. Floats on the gas in the float chamber and controls the float needle to permit gas to enter the float as the engine demands

_____k. A bowl that serves as a reservoir for fuel coming from the fuel line

4. Select true statements concerning air-fuel ratios by placing an "X" beside each statement that is true.

_____a. The amount of air mixed with a given quantity of fuel determines the limits of combustion in an engine and controls overall performance.

_____b. An air-fuel ratio of 14.7 parts of air to 1 part of gasoline is considered the perfect mixture, but operating conditions are always less than perfect and a ratio of 10:1 actually delivers more power.

_____c. An air-fuel mixture that is too rich will burn well, decrease fuel consumption, produce excessive hydrocarbons and carbon monoxide, and cause spark plug fouling.

_____d. An air-fuel ratio that is too lean will burn poorly because the fuel particles are too far apart, and the ratio can cause surging at low speeds and engine overheating.

_____e. Because a cold engine reduces vaporization, cold starting requires a lean air-fuel ratio and this is usually provided with a manually operated choke or a fuel enrichener.

_____f. Air-fuel ratios are controlled by carburetor circuits designed specifically for the different operating ranges of the engine.

TEST

5. Match terms related to carburetor circuits with their correct functions.

_____a. Maintains a specific fuel level in the float chamber at all times

_____b. Meters the air-fuel mixture at idle and at small throttle openings (sometimes called the idle circuit)

_____c. Regulates the air-fuel ratio as the carburetor moves from the low-speed circuit to the mid-range circuit

_____d. A combination of circuits which work together to maintain the correct air-fuel ratio between ¼ throttle and ¾ throttle

_____e. Controlled by the main jet and regulates the air-fuel ratio from ¾ throttle to full open throttle

_____f. Controlled by an additional starting circuit to provide an extremely rich mixture for cold starting

1. High-speed circuit
2. Mid-range circuit
3. Low-speed circuit
4. Float circuit
5. Enrichener circuit
6. Transition circuit

6. Select true statements concerning float circuit components and operations by placing an "X" beside each statement that is true.

_____a. The major components of the float circuit are the fuel bowl, float valve and seat assembly, and the float(s).

_____b. The fuel level in the fuel bowl must be high enough so that the main pilot and starter circuits extend into the fuel supply so there will be an intermittent supply of fuel.

_____c. The fuel level affects how rich or lean the engine will run.

_____d. If the fuel level is too high, the vacuum in the venturi will not be strong enough to pull sufficient fuel out of the bowl into the air stream, and a lean mixture will result.

_____e. If the fuel level is too high, the vacuum in the venturi will have to lift the fuel a shorter distance and a rich mixture will result.

_____f. To measure the fuel level, the engine must be running, but since this is not always possible, the float level is measured instead, and the measurement is made from the top of the float to the carburetor body gasket surface using a special float gauge.

_____g. Adjusting the float level is accomplished by bending the float arms or a tab that will raise or lower the fuel level.

_____h. The float level must always be set to the manufacturer's recommended setting.

TEST

7. Complete statements concerning low-speed circuit components and operations by inserting the word(s) that best completes each statement.

   a. The low-speed or pilot circuit is a series of ____________ in the carburetor body.

   b. The ____________ ____________ meters fuel and a ____________ ____________ meters air to provide a correct air-fuel ratio during idle.

   c. Sometimes the metering for ____________ is controlled by an air jet and a pilot jet, and the ____________ ratio is predetermined by the size of the jets.

   d. In the two-jet system, the amount of air-fuel mixture is regulated by the ____________ ____________.

   e. ____________ for the pilot circuit enters through a small passage in the inlet side of the venturi, is mixed with a small amount of fuel from the fuel chamber, and enters the ____________ ____________ on the engine side as an ____________ ____________ mixture.

   f. Some pilot jets have small air bleed holes to allow air to mix with fuel and partially ____________ the mixture in the carburetor body before it reaches the venturi.

8. Complete statements concerning transition circuit components and operations by inserting the word(s) that best completes each statement.

   a. The ____________ ____________ is controlled primarily by the amount of cutaway on the bottom of the throttle slide.

   b. The cutaway functions like the restriction in a venturi and causes air to accelerate and form a ____________ that draws small amounts of fuel from both the low-speed and mid-range circuits.

   c. As the height of the cutaway increases, the air-fuel ratio becomes ____________; as the height of the cutaway decreases, the air-fuel ratio becomes ____________.

   d. ____________ ____________ are available with different degrees of cutaway to permit carburetor adjustments in the ⅛ throttle to ¼ throttle range.

9. Select true statements concerning mid-range components and operations by placing an "X" beside each statement that is true.

   _____a. The mid-range circuit is a combination circuit that draws from both the low-speed circuit and the transition circuit, but the jet needle and needle jet are the primary controllers of the transition circuit.

   _____b. The tapered jet needle is attached to the throttle slide and points upward through the center of the carburetor venturi.

TEST

_____c. The tapered end of the jet needle fits into the needle jet which is located in the carburetor body.

_____d. The air flow is controlled by the slide and the fuel flow is controlled by the clearance between the jet needle and the needle jet.

_____e. As the slide is raised, it raises the jet needle out the the needle jet and creates a greater clearance between the jet needle and the needle jet and allows more fuel to flow from ¼ to ¾ throttle.

_____f. There are usually two grooves in the top of the jet needle that permit adjustment of the most important part of the mid-range circuit.

_____g. Lowering the clip raises the jet needle and the air-fuel ratio becomes leaner while raising the clip lowers the needle and the air-fuel ratio becomes richer.

_____h. Jet needles are not available with different degrees of taper, but needle jets are available in different sizes to allow for fine tuning.

10. Complete statements concerning high-speed circuit components and operations by inserting the word(s) that best completes each statement.

    a. The main jet is the primary component of the high-speed circuit and is located in the fuel passage between the ____________ ____________ and the ____________ ____________.

    b. All fuel flowing through the ____________ ____________ must flow through the main jet.

    c. At approximately ¾ throttle opening, the clearance between the needle jet and jet needle becomes ____________ than the size of the hole in the main jet.

    d. The ____________ ____________ meters fuel flow from ¾ throttle to full open.

11. Complete statements concerning enrichener circuit components and operations by inserting the word(s) that best completes each statement.

    a. Since a cold engine does not contain enough heat to vaporize droplets of fuel in an ordinary air-fuel mixture, the carburetor needs to feed a ____________ mixture to the engine for cold starting.

    b. The ____________ ____________ is sometimes a cold-start circuit or simply a choke, and is a special fuel circuit dedicated to making the engine easy to start when it is cold or hasn't recently been started.

    c. A ____________ restricts the amount of air that can enter the carburetor and causes a high vacuum which pulls an additional quantity of fuel out of the fuel bowl to provide a mixture rich enough to start the engine.

TEST

d. Another type of __________ __________ __________ is called the enrichener or starter circuit.

e. The enrichener circuits consist of:

   1) A __________ __________ to meter the fuel

   2) A __________ which opens an air passage from the inlet of the carburetor, around the slide, so that incoming air re-enters on the engine side of the slide

f. With the __________ lifted, air rushes through the passage and causes a venturi effect which causes an additional amount of fuel to flow through the __________ __________ and into the engine.

g. The __________ __________ must be closed for the enrichener circuit to operate, and the plunger must be manually lifted from its seat.

12. Complete statements concerning the interrelationship of carburetor circuits by inserting the word(s) that best completes each statement.

   a. Although it is easier to understand fuel circuit functions by talking about each circuit individually, __________ __________ __________ totally controls carburetor operation at any one time.

   b. Respecting the carburetor as a single functioning system is important when considering a __________ __________.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

13. Demonstrate the ability to:

   a. Remove, disassemble, clean, reassemble, and install a one-cylinder motorcycle carburetor. (Job Sheet #1)

   b. Remove, clean, and install a fuel valve. (Job Sheet #2)

CARBURETORS AND FUEL SYSTEMS
UNIT IX

ANSWERS TO TEST

1. a. 4
   b. 5
   c. 2
   d. 1
   e. 6
   f. 3

2. a. Atmospheric pressure, air
   b. Vacuum, vacuum
   c. Venturi, venturi, "venturi effect"
   d. Lessen
   e. Fuel jet nozzle
   f. Atmospheric pressure
   g. Atomized
   h. Cylinder
   i. Air, fuel

3. a. 7
   b. 10
   c. 4
   d. 3
   e. 11
   f. 1
   g. 5
   h. 8
   i. 9
   j. 2
   k. 6

4. a, d, f

5. a. 4
   b. 3
   c. 6
   d. 2
   e. 1
   f. 5

6. a, c, e, g, h

7. a. Passages
   b. Pilot jet, pilot screw
   c. Idle, air-fuel
   d. Pilot screw
   e. Air, air stream, atomized air-fuel
   f. Atomize

8. a. Transition circuit
   b. Vacuum
   c. Leaner, richer
   d. Throttle slides

9. c, d, e

ANSWERS TO TEST

10. a. Float chamber, needle jet
    b. Needle jet
    c. Greater
    d. Main jet

11. a. Richer
    b. Enrichener circuit
    c. Choke
    d. Cold starting system
    e. 1) Starter jet
       2) Plunger
    f. Plunger, starter jet
    g. Throttle slide

12. a. No one circuit
    b. A jetting change

13. Performance skills evaluated by practical tests

WHEELS AND TIRES
UNIT X

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify parts of a wheel assembly and a tire and discuss procedures for spoking and trueing wheels. The student should also be able to remove, replace or repair, and install front and rear motorcycle tires and ATV tires. These competencies will be evidenced by correctly performing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to wheels and tires with their correct definitions.
2. Complete statements concerning types of wheels.
3. Match parts of a tire with their characteristics.
4. Complete statements concerning tire tools and equipment.
5. Complete a list of other supplies required for tire repair.
6. Solve problems concerning tire markings.
7. Complete statements concerning valve stems and valve caps.
8. Select true statements concerning tubeless tire repair.
9. Complete statements concerning tire liabilities.
10. Match spoke and rim terms with their meanings.
11. Match wheel trueing terms with their meanings.
12. Select true statements concerning spoke patterns.
13. Complete a list of guidelines for spoking and trueing wheels.

OBJECTIVE SHEET

14. Complete statements concerning ATV tires.

15. Complete statements concerning personal safety around wheels and tires.

16. Demonstrate the ability to:

    a. Remove, replace/repair, and install a front tire and wheel assembly on a motorcycle. (Job Sheet #1)

    b. Remove, replace/repair, and install a rear tire and wheel assembly on a motorcycle. (Job Sheet #2)

    c. Replace a damaged rim and respoke and true a motorcycle wheel. (Job Sheet #3)

    d. Remove, replace/repair, and install a tire on an ATV. (Job Sheet #4)

    e. Make inside and outside repairs on ATV tires. (Job Sheet #5)

WHEELS AND TIRES
UNIT X

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparency.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Show samples of all three types of spoke patterns and explain their differences.

H. Demonstrate the procedure of replacing one spoke in a wheel that is already spoked so students will get the idea of how other spokes have to be removed.

I. Talk to the class about ATV tires in general, how important ATV tire repair has become to motorcycle service, and demonstrate the tricks of the trade for working with ATV tires.

J. Impress upon the students the importance of motorcycle tire service and the important role it plays in service department income.

K. Discuss the concepts of "liability" in tire repair and encourage students to follow all tire mounting procedures to the letter.

L. Use video tapes as appropriate for visual reinforcement of objectives and job sheets. S1041—*Tubeless Tire Repair* is available at educational rates in 1/2" VHS or Beta video tapes from:

American Honda Motors Co., Inc.
Motorcycle VoTech
100 West Alondra Blvd.
Gardena, CA 90248-2702

M. Other videos to help reinforce this unit include *Wheel Lacing and Truing* and *Wheel Balancing*. These videos are available in 3/4" U-Matic, 1/2" Beta I, 1/2" Beta II, or 1/2" VHS formats from:

Kawasaki Motors Corp., U.S.A.
Service Training
9950 Jeronimo Road
Irvine, CA 92718-2016

N. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics.* New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

C. Johns, Bruce A., and David D. Edmundson. *Motorcycles Fundamentals, Service, Repair.* South Holland, IL: The Goodheart-Willcox Co., Inc., 1984.

D. *Official Honda Shop Manual '78-'81 CB/CM400's.* Gardena, CA: Honda Motor Co., Ltd., 1980.

WHEELS AND TIRES
UNIT X

INFORMATION SHEET

I. **Terms and definitions**

A. Liable — Legally obligated to assume responsibility for product malfunctions or for improper repairs that endanger persons or property

B. Off-road motorcycles — Motorcycles that generally are not licensed for use on streets or highways, but rather in motocross racing or general pleasure riding

Example: Motocross bikes and ATV's

C. Street bikes — Motorcycles that are designed for licensed use on public streets and highways

D. Lifetime valve stem — A metal valve stem that will not weather or wear out

E. Weather cracks — A form of tire and rubber valve deterioration caused by exposure to sun, wind, and rain

F. Valve stem — A short, rubber valve installed in a rim to permit inflation and deflation of a tire

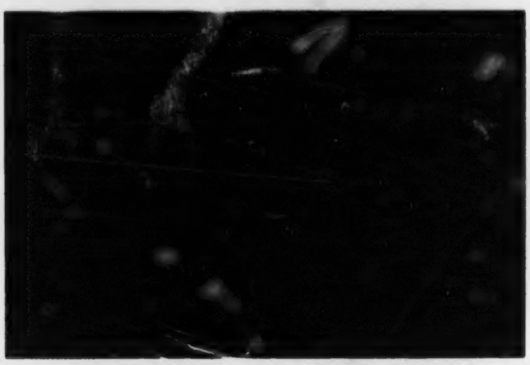
G. Valve core — A spring-loaded device inserted into a valve stem to turn the valve stem into a one-way valve that will permit air to enter but will not permit air to escape

H. Seating ring — A rubber ring that can be installed between the rim and one bead of a tubeless ATV tire to provide a temporary seal on one side of the tire and help seat the tire as it is inflated

II. **Types of wheels**

A. Spoke wheels are fastened to the hub by spokes and require periodic inspection and maintenance. (Figure 1)

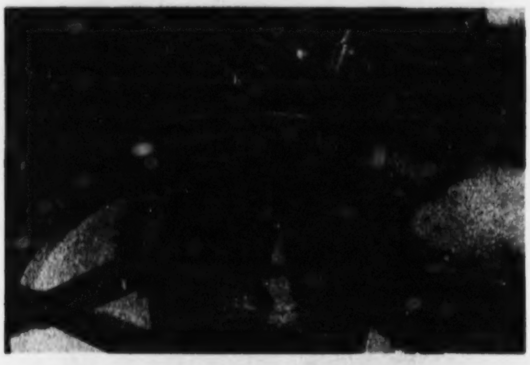
FIGURE 1



INFORMATION SHEET

B. Mag wheels are made mostly of aluminum, are practically maintenance free, and have a modern look that enhances the appearance of a motorcycle. (Figure 2)

FIGURE 2



C. Extruded wheels usually have three pieces, are either spoke or mag-type riveted to a rim, and are popular because of their light weight. (Figure 3)

FIGURE 3

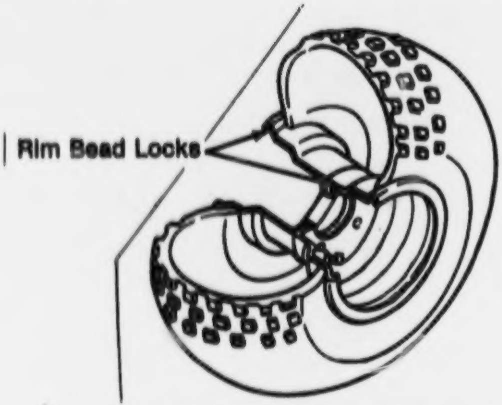
D. Tube-type wheels are usually spoked wheels and are used primarily for off-road applications.

E. Tubeless wheels are used primarily on street bikes because they run cooler and require less service.

INFORMATION SHEET

F. Bead-lock wheels are used with tubeless tires on ATV's because extremely low tire pressures are used and the bead lock keeps the tire on the rim. (Figure 4)

FIGURE 4



Courtesy Yamaha Motor Corporation, U.S.A.

III. Parts of a tire (Figure 5)

A. Bead — The steel-reinforced inner circle on a tire that seats onto the rim

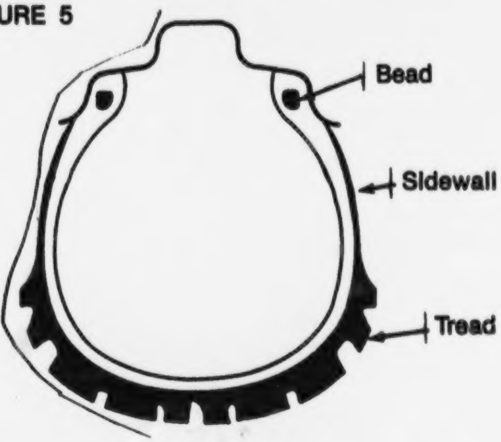
B. Radial-ply — A tire that has a cord body that runs straight around the tire from one bead to the other and is covered with a belt that runs around the circumference of the tire underneath the tread

C. Bias-ply — A tire that has a cord body that runs diagonally from one bead to the other and may use several plies

D. Sidewall — The part of a tire that extends from the bead to the tread

E. Tread — The outer part of the tire that contacts the road with grooves designed to shed water and grip the road

FIGURE 5



INFORMATION SHEET

IV. Tire tools and equipment

A. The Coats 200/220 motorcycle tire changer is probably the most used piece of equipment in tire service. (Figure 6)

FIGURE 6

B. A wheel balancer is used on almost all tire changes to insure longer tire life and safety. (Figure 7)

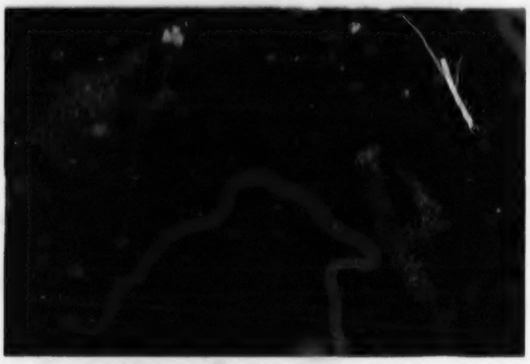
FIGURE 7

C. A bubble balancer works with a bubble like the bubble in a carpenter's level, but a dynamic balancer is computerized to locate areas on the tire where weight is required and how much weight is required.

INFORMATION SHEET

D. A tire tool is a slim, flat tool spoon-shaped on one end and straight on the other so it can be used to pry the tire off the rim. (Figure 8)

FIGURE 8



E. ATV bead breakers come in several different designs, but all of them are built to help remove an ATV tire from a bead-lock rim without damaging either the tire or the rim.

F. A valve stem installing tool is used to install a rubber valve stem in a tubeless wheel, and the tool helps prevent damage to the valve stem during installation.

G. A low pressure gauge is used to measure ATC tire pressures which may range from half a pound to about 5 pounds, and a high pressure gauge is used for all other tires. (Figure 9)

FIGURE 9

V. **Other supplies required for tire repair**

A. Tubeless and ATV tire repair kits

B. Rubber lubricant to prevent damage to the bead of the tire and to insure proper seating of the bead

C. Tubeless valve stems

INFORMATION SHEET

D. A valve core removing tool

E. Valve caps

F. Chalk or grease pencil to mark puncture locations (Figure 10)

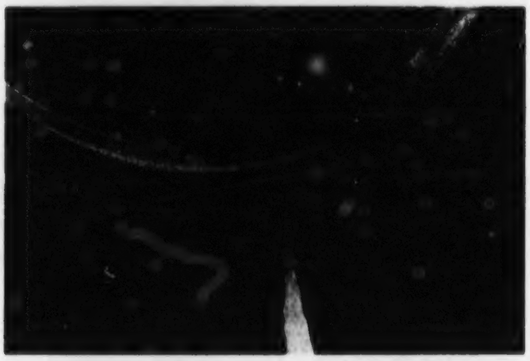
FIGURE 10

VI. **Tire markings**

A. Almost all tires have a marking on them that is called the balance mark which might be in the form of zero painted onto the tire sidewall or a small dab of highly visible paint.

B. The balance mark indicates the most lightweight spot on the tire, and the balance mark should always be lined up with the valve stem when installing a tire. (Figure 11)

FIGURE 11



C. Aligning the lightweight side of the tire up with the extra weight of the valve stem helps balance out the opposite heavy side of the tire where rubber laps rubber to hold the tire together.

INFORMATION SHEET

D. Directional arrows appear on a tire sidewall to indicate that the tire should be installed so that the arrows point to the same direction the wheel rotates when the bike goes forward.

E. Some tires may be used either front or rear and are called dual-purpose tires.

F. Dual-purpose tires sometimes have directional arrows going one way if it is used as a front tire and going the opposite direction if it is used as a rear tire.

VII. **Valve stems and valve caps**

A. When installing a new tire, a new valve stem should be installed unless the valve stem is a metal lifetime stem.

B. Valve stems must be seated all the way to the seating flange and should always be checked to make sure it was not damaged during installation.

C. When first inflating a tubeless tire, it requires a great volume of air and the valve core usually has to be removed to get a sufficient air supply into the tire.

D. After initial inflation of a tube, the valve core should be removed to deflate the tube and permit it to adjust to the tire and free itself of wrinkles.

E. Always place a valve cap on the valve stem to protect the valve core from mud and water.

VIII. **Tubeless tire repair**

A. Always locate and mark puncture locations before removing a tire.

B. Tubeless tire repair is generally not recommended, but is acceptable if the tire is repaired with a permanent plug patch.

C. The plug patch is installed from inside the dismounted tire and consists of one-piece plug that goes through the puncture and an attached plug cap which is sealed to the interliner of the tire.

D. Plug patches should be used only on small punctures that are in the tread area of the tire and never on punctures in the sidewall.

E. It is not recommended to install a tube in a tubeless tire on a wheel that is designed for a tubeless tire because the rough inside of the rim will rub a hole in the tube and could cause overheating problems too.

INFORMATION SHEET

IX. **Tire liabilities**

A. If a new tire in a street bike tire goes bad, the manufacturer might be liable if it results in injury, but if a patched tube goes bad, the dealership could be liable, so the rule is to never patch a tube.

B. Never install a tire sized above or below what the manufacturer recommends because an oversize tire could rub the frame and an undersize tire won't handle the load.

C. Some tires are specified for use with only certain models of motorcycles and should not be used on any other vehicles.

D. Tires marked "Rear" should be used only on a rear wheel, and tires marked "Front" should be used only on a front wheel.

E. When a tire has directional arrows on it, it should be mounted with the arrows moving in the direction of forward rotation.

F. A new front tire matched with a worn rear tire will result in instability, and the customer should be encouraged to install a matched set.

G. After mounting, wash all tires with water and a brush to assure that the slick residue left from manufacturing or lubricants used in mounting are totally removed because the combination of the two can cause a tire to slide out of control.

(NOTE: Tires are formed in molds that are coated with a soap-like agent to keep the tire from sticking to the form.)

H. After the tire is installed on the motorcycle, spin the tire to make certain that the bead is seated on the rim and that the tire runs straight and true.

I. Check spoked wheels for loose or missing spokes and tighten or replace as needed before mounting a new or used tire.

X. **Spoke and rim terms and their meanings**

A. Spoke — A metal rod that attaches the rim of the wheel to the hub of the wheel

B. Spoke nipple — A long nut that goes through the rim and screws onto the spoke to secure it to the rim

C. Rim — The round metal part of the wheel that the tire fits on to

D. Drop center — The small or recessed part of the rim that allows enough clearance for the bead of the tire to be removed from the rim

INFORMATION SHEET

E. Hub — The center of the wheel assembly that contains the wheel bearings and the brake drum or rotor, and has holes in it for attaching spokes

F. Rim liner — A strip of rubber that goes around the rim to protect the tube from the spoke nipples

G. Inner spoke — A spoke that extends from the inside of the hub to the rim and has more than a 90° bend at the spoke head

H. Outer spoke — A spoke that extends from the outside of the hub to the rim and has less than a 90° bend at the spoke head

I. Spoke wrench — A thick, special design wrench for tightening or loosening spokes

XI. **Wheel trueing terms and their meanings**

A. Lateral runout — The degree to which a wheel wobbles back and forth as it turns

B. Radial runout — The degree to which a wheel moves up and down from a center axle as it turns

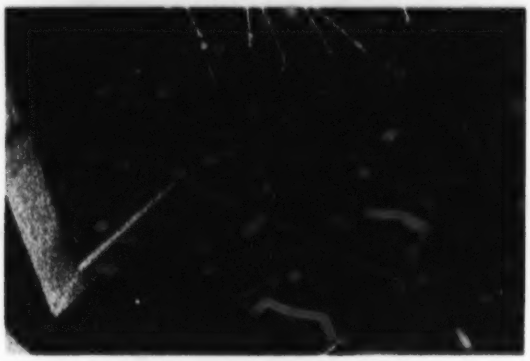
C. Straight and true — A phrase used to indicate the combination of lateral runout which is straight and radial runout which is true

D. Dial indicator — A precision measuring tool that accurately measures lateral runout so it can be straightened

E. Trueing stand — A stand with an axle that goes through a hub to securely mount a wheel assembly for convenient access by a technician (Figure 12)

F. Pointer — A metal rod that attaches to a trueing stand in such a way that it can be used as a reference point for checking lateral and radial runout and also serves as a mounting base for the dial indicator (Figure 12)

FIGURE 12



INFORMATION SHEET

XII. **Spoke patterns**

A. All spoke patterns cross in some fashion to give the rim strength and stability.

B. A cross-one spoke pattern means that a spoke must cross one other spoke on the same side (inner or outer) that is going in the opposite direction.

C. A cross-two spoke pattern means that a spoke must cross two other spokes on the same side that are going in the opposite direction, and a cross-two pattern is the most common.

D. A cross-three pattern means that a spoke must cross three other spokes on the same side that are going in the opposite direction.

E. The number of spokes that a wheel contains will always be in multiples of four, and 36 is the most common.

XIII. **Guidelines for spoking and trueing wheels**

A. Old spokes are almost never reused because they are stretched, the threads are rusted, and the threads are usually damaged.

B. Since old spokes are of no further use, the fastest way to remove them is with a cutting torch or bolt cutters.

C. If a spoked wheel is noticeably bent, it cannot be straightened and should be replaced for safety reasons.

D. Always be careful to never overtighten spokes because they could ruin the hub and break the spoke.

E. Off-road wheels don't have to run as true as street-bike wheels, but both should run straight and true, and if there is any doubt, the wheel should be checked in a wheel-trueing stand with a dial indicator.

F. Specifications for trueing a wheel are almost always found in the appropriate service manual.

XIV. **ATV tires**

A. The popularity of all terrain vehicles has made ATV tire repair an important part of motorcycle service.

B. The most difficult part of servicing an ATV tire is breaking the bead away from the rim.

C. ATV wheels are so small that they're difficult to hold unless they are secured in a tire changing machine.

INFORMATION SHEET

D. Mounting ATV tires requires liberal use of tire lubricant.

E. The wide rims make it difficult to seat the bead initially so the tire can be aired up, and sometimes a tube has to be placed inside the tire and inflated enough to seat one bead, then deflated and removed.

F. ATV tires can frequently be repaired from the outside without being dismounted.

G. ATV tires are sometimes directional because of tread pattern, but they do not have directional arrows so you have to pay special attention to right and left hand tires.

H. Always keep ATV tire pressure within the low pressure limits specified.

I. Rear tires have to be the same diameter, and this may require unequal air pressure to compensate for a tire that has been stretched.

XV. **Personal safety around wheels and tires**

A. Before mounting a new tire, inspect the wheel for cracks or damage because if the wheel is bad there is no need to mount the tire and it poses a danger of exploding during inflation.

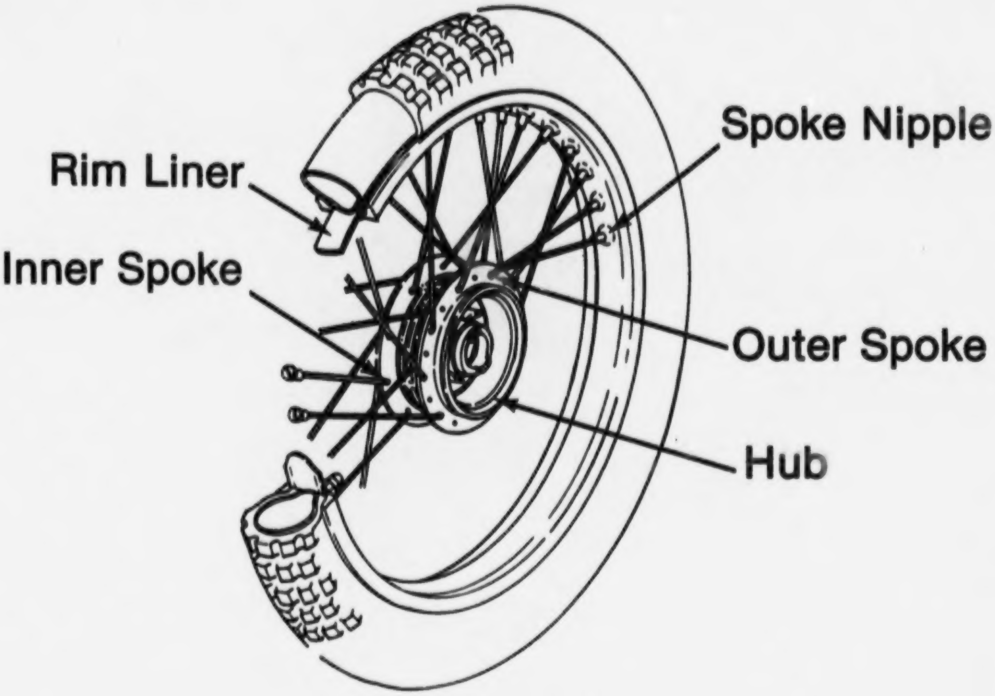
B. Never attempt to seat the bead on a tire by inflating the tire beyond the recommended seating pressure stamped on the tire.

(CAUTION: The maximum inflating pressure for most motorcycle tires is 40 PSI, and going beyond that could cause a tire to explode or cause the rim to break.)

C. Because sprockets are sharp and can cause severe injuries, remove tires from the opposite side of the sprocket, and remove a sprocket if it will not fit into a tire changer.

D. Before you test drive a motorcycle after tire replacement, make sure the brakes are working properly.

Wheel and Rim Assembly


Spoke Nipple
Rim Liner
Inner Spoke
Outer Spoke
Hub

Courtesy Yamaha Motor Corporation, U.S.A.

WHEELS AND TIRES
UNIT X

JOB SHEET #1 — REMOVE, REPLACE/REPAIR, AND INSTALL A FRONT TIRE AND WHEEL ASSEMBLY ON A MOTORCYCLE

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Torque wrench
6. Tire removing machine/equipment
7. Tire changing lubricant
8. Pencil
9. Safety glasses

B. Routine #1 — Removing the front wheel

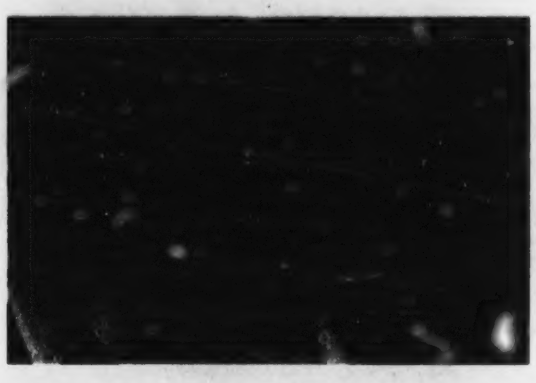
1. Put on safety glasses.
2. Raise the front wheel off the ground and support the motorcycle firmly so that it cannot fall.
3. Remove the speedometer cable, if required. (Figure 1)

FIGURE 1

JOB SHEET #1

4. Remove the brake caliper(s), if required. (Figure 2)

FIGURE 2



5. Remove the front brake cable, if required.

6. Remove the front fender, if required.

7. Remove the axle nut cotter key, if required. (Figure 3)

FIGURE 3

JOB SHEET #1

8. Remove the axle holders, if required. (Figure 4)

   (NOTE: Sketch the markings on the axle holders because they are directional and have to go back exactly where they come from.)

   FIGURE 4

9. Remove the axle nut. (Figure 5)

   FIGURE 5

10. Remove the front axle, if required.

    (NOTE: There is frequently a hole on the other side of the axle flange so you can insert a punch that will allow you to turn the axle and work it out even if it's a bit rusty.)

11. Use a soft-face mallet if you have to strike the axle to loosen it, but do not pound the axle with a hard-faced hammer.

JOB SHEET #1

12. Take special care to notice the position of bushings, spacers, and speedometer drive gears as you remove the axle, and if you need to, make a note or a sketch of how things are arranged. (Figure 6)

FIGURE 6

13. Remove the front wheel assembly. (Figure 7)

FIGURE 7

14. Remove all bushings, spacers, and speedometer drive gear so they won't get lost while you're working on the wheel assembly.

JOB SHEET #1

15. Remove the valve cap and valve core and let the air out of the tire. (Figure 8)

FIGURE 8

16. Remove the valve stem lock nuts if it is a tube-type tire.

☐ Have your instructor check your work.

17. Ask your instructor whether you are to complete your job with tire tools or with a tire changing machine:

    a. If you're using tire tools, go on to Routine #2.

    b. If you're using a tire changing machine, skip to Routine #3.

C. Routine #2 — Changing a tire with tire tools

1. Leave your safety glasses on.

2. Break the tire away from the bead of the rim with a bead breaker or force it off with the heel of your shoe, but be careful not to scratch or damage the rim. (Figure 9)

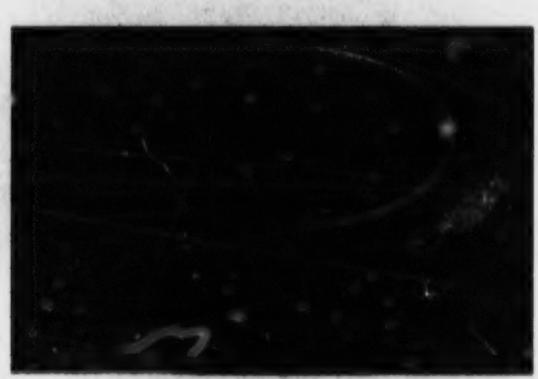
FIGURE 9

JOB SHEET #1

3. Place the tire and wheel assembly on a suitable work surface that will allow the assembly to lie flat. (Figure 10)

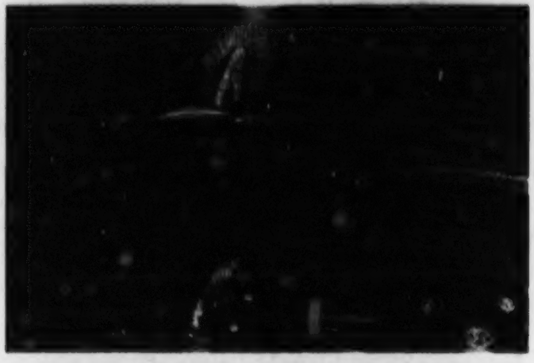
   (NOTE: A strong, open-top wooden box or even a sturdy trash can provides good support.)

   FIGURE 10



4. Lubricate the tire bead generously with tire lubricant. (Figure 11)

   FIGURE 11



5. Insert the hooked end of a tire tool on one side of the valve stem and insert the straight end of another tire tool on the other side of the valve stem so that the two tire tools are about four inches apart. (Figure 12)

   FIGURE 12

JOB SHEET #1

6. Pry the bead up and over the rim with both tire tools, making certain that you don't pull the tube up with the bead. (Figure 13)

FIGURE 13

7. Pull the straight-ended tire tool out and move it over about four inches and reinsert it between the bead and the rim. (Figure 14)

FIGURE 14

8. Pry the tire up once more and continue this procedure around the tire until you have that side of the tire completely over the rim. (Figure 15)

FIGURE 15

JOB SHEET #1

9. Remove the tube, if there is one.

10. Start with the tire tools on either side of the valve stem and repeat the procedure used for the other side. (Figure 16)

    (NOTE: Sometimes the tire tool with the straight end has to be installed in line with the bead and then turned at a right angle to get the second side of the tire off, and this is where the rim often gets damaged, so work with care.)

FIGURE 16

11. Remove the tire completely and set it aside.

12. Inspect the rim for cracks, bends, or nicks that could make further use of the rim dangerous.

13. Clean the seating surfaces of the rim thoroughly with a wire brush, and remove all corrosion or rust. (Figure 17)

FIGURE 17

☐ Have your instructor check your work.

14. Check the tire you intend to put back on the bike to make sure the bead is free of defects and damage.

JOB SHEET #1

15. Check inside the tire for damage or the presence of foreign objects.

16. Check the valve stem, if it is a tubeless tire, and replace it if it is damaged.

17. Check the directional arrow on the tire to determine which side of the tire goes on the wheel first.

18. Lubricate the beads with rubber lubricant.

19. Push the first bead onto the rim by hand, and then continue with the hooked end of the tire tool until you get the complete bead on one side of the wheel. (Figure 18)

FIGURE 18

20. Inflate the tube just enough to get all the wrinkles out if it is a tube-type tire you're mounting.

21. Position the tire so that the balance mark is in line with the valve stem. (Figure 19)

(NOTE: The balance mark may be a circle or a dab of paint that will be highly visible.)

FIGURE 19

JOB SHEET #1

22. Work the tube valve stem in first and start one of the valve stem lock nuts to hold it in place if it is a tube-type tire.

23. Work the rest of the tube into the tire and over the rim.

24. Get the tube well up into the central part of the tire so that you won't run the risk of punching it when you install the other bead.

25. Pick a spot fairly close to either side of the valve stem and insert the hooked end of one tire tool, then move about four inches away, insert the other tire tool and start prying the bead over the rim. (Figure 20)

    (NOTE: Don't insert either tire tool deeper than it needs to be or you will pinch or puncture the tube.)

FIGURE 20

26. Continue working around the tire until the bead is over the rim.

27. Take special care with the final area around the valve stem because it may require that you position your tire tools closer together.

28. Turn the tire slightly one way and then the other to make sure the beads are properly set.

29. Check once again to make sure the balance mark and the valve stem are still aligned and that the valve stem points straight up and is not slanted to one side.

30. Pull the valve stem out and run the lock nut all the way down and lightly tighten it.

31. Install the second lock nut over the valve stem and snug it down onto the first one.

JOB SHEET #1

32. Inflate the tire until the beads seat completely on the rim, but do not exceed 40 PSI or the maximum bead-seating inflation pressure listed on the tire. (Figure 21)

FIGURE 21

33. Let all the air out of the tire to allow the tube to position itself properly and shake out all the wrinkles.

34. Install the valve core.

35. Inflate the tire to its recommended operating PSI and install a valve cap.

36. Check the tire to make sure there are no bulges or irregularities, and make sure the bead is seated evenly and firmly around the rim.

    (NOTE: Each side of the tire will have seating marks that provide visual guides to help check for uniform seating.)

37. Wash the tire with water and scrub brush until you are sure it is free of soap and tire mounting lubricant.

☐ Have your instructor check your work.

D. Routine #3 — Changing a front tire with a tire changer

1. Leave your safety glasses on.

2. Place a shop towel over the chassis pad on the machine if you're working with an aluminum rim so you won't damage the rim.

JOB SHEET #1

3. Break the tire away from the bead of the rim with the bead loosening shoe on the tire changing machine. (Figure 22)

FIGURE 22

4. Place the tire and wheel on the table top and position the wheel so that it engages the hook portions of the clamps and the valve stem is directly over the stationary clamp that is on your left to mark the starting position for diamounting the tire.

(NOTE: Install clamp pads if you're working with an aluminum rim.)

5. Tighten the clamping screw until the screw operated clamp engages the rim, and then tighten it moderately. (Figure 23)

FIGURE 23

JOB SHEET #1

6. Rotate the pivot arm over the wheel and lock into position. (Figure 24)

FIGURE 24

7. Lower the center post to about 3 cm above the wheel and tighten the knob. (Figure 25)

FIGURE 25

8. Apply rubber lubricant to the bead and to the demount end of the combination tool. (Figure 26)

(NOTE: Install the demount protector boot on the combination tool if you're working with an aluminum rim.)

FIGURE 26

JOB SHEET #1

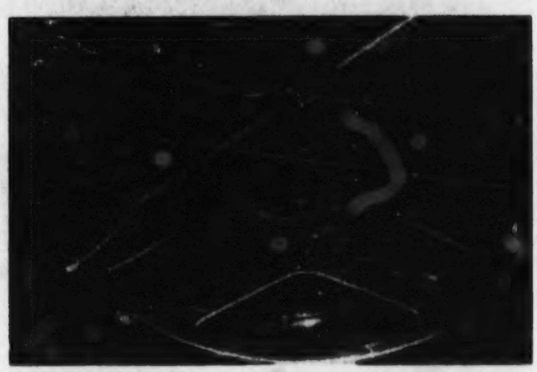
9. Insert the combination tool underneath the upper bead at about a 45° angle away from the tire. (Figure 27)

FIGURE 27

10. Pivot the tool over and against the center post, taking care not to pinch the tube. (Figure 28)

(NOTE: Using plenty of rubber lubricant will usually prevent tube pinching.)

FIGURE 28



11. Rotate the combination tool in a clockwise direction with one hand while lifting up on the tire with your other hand at the starting position.

12. Remove the tube, if there is one, before dismounting the bottom bead, and move the pivot arm back if you need to make it easier to take the tube out.

JOB SHEET #1

13. Remove the bottom bead with the same procedure outlined for removing the top bead. (Figure 29)

FIGURE 29

14. Remove the tire from the rim and place it aside.

15. Remove the rim from the machine by loosening the clamping screw.

16. Inspect the rim for cracks, bends, or nicks that could make further use of the rim dangerous.

17. Clean the seating surfaces of the rim thoroughly with a wire brush, and remove all corrosion or rust. (Figure 30)

FIGURE 30

☐ Have your instructor check your work.

18. Place the rim back on the machine.

19. Check the valve stem, if it is a tubeless tire, and if it shows signs of damage or weather cracking, replace it.

20. Check the tire you intend to put back on the bike to make sure the bead is free of defects and damage.

JOB SHEET #1

21. Check inside the tire for damage or the presence of foreign objects.

22. Check the directional arrow on the tire to determine which side of the tire goes on the wheel first.

23. Lubricate the beads with rubber lubricant.

24. Position the tire so that the balance mark is in line with the valve stem. (Figure 31)

FIGURE 31

25. Push the first bead into the rim by hand.

26. Inflate the tube just enough to get all the wrinkles out if it is a tube-type tire you're mounting.

27. Work the valve stem in first and start one of the valve stem lock nuts to hold it in place.

28. Work the rest of the tube into the tire and over the rim.

29. Get the tube well into the central part of the tire so that you won't run the risk of pinching it when you install the other bead.

30. Lubricate the top bead again.

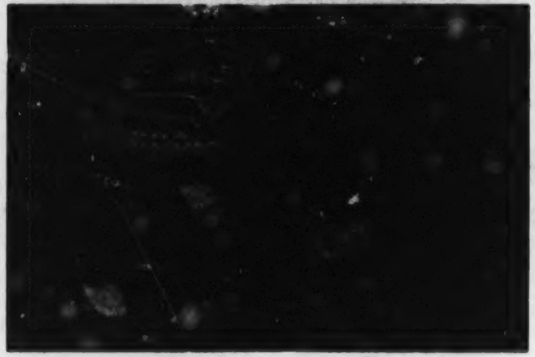
JOB SHEET #1

31. Position the mounting end of the combination tool just to the right of the valve stem so that it engages the rim and the bead of the tire. (Figure 32)

FIGURE 32

32. Pull the mounting tool around the tire in a clockwise direction with one hand as you push down on the tire with your other hand. (Figure 33)

FIGURE 33



33. Move the mounting tool around until the tire is completely mounted.

34. Turn the tire slightly one way and then the other to make sure the beads are properly set.

35. Check once again to make sure the balance mark and the valve stem are still aligned and that the valve stem points straight up and is not slanted to one side.

36. Pull the valve stem out and run the lock nut all the way down and lightly tighten it.

37. Install the second lock nut over the valve stem and snug it down on the first one.

(CAUTION: The tire and wheel must be removed from the machine before inflating the tire.)

38. Remove the tire and wheel from the machine.

JOB SHEET #1

39. Inflate the tire until the beads seat completely on the rim, but do not exceed 40 PSI or the maximum bead-setting inflation pressure listed on the tire.

40. Let all the air out of the tire to allow the tube to position itself properly and shake out all the wrinkles.

41. Install the valve core.

42. Inflate the tire to its operating PSI and install a valve cap.

43. Check the tire to make sure there are no bulges or other irregularities, and make sure it is seated evenly and firmly around the rim.

    (NOTE: Each side of the tire will have seating marks that provide visual guides to help check for uniform seating.)

44. Wash the tire with water and a scrub brush until you are sure it is free of soap and tire mounting lubricant.

☐ Have your instructor check your work.

E. Routine #4 — Installing the front wheel

1. Leave your safety glasses on.

2. Recheck the air pressure in the tire after washing to make certain there hasn't been a noticeable pressure loss which would indicate a leak.

3. Review your sketch or notes made when you took the front wheel off, and put the bushings, spacers, and speedometer drive gear back into the hub in proper location.

   (NOTE: Take special care with the speedometer drive gear lugs because they must be properly engaged in the slots inside the hub and seated all the way down to avoid damage.)

4. Position the wheel assembly in the front forks and slide the axle through, or install the axle holders as required.

   (NOTE: Axle holders are directional and must be installed in the same position and direction that they are removed.)

5. Position the speedometer drive gear and reinstall the speedometer cable.

6. Check the service manual for the specified torque for the axle or axle holders and torque to specifications.

7. Install the cotter key and bend the ends to secure it.

JOB SHEET #1

8. Reinstall the brake caliper and torque it to specifications in the service manual if the bike is so equipped, and pump the front brake handle to make sure the pads seat properly.

9. Install the front brake cable and adjust it to specification in the service manual.

10. Reinstall front fender if it was removed.

11. Spin the wheel to make sure that it runs straight and true and that it is seated properly on the rim.

12. Make a final check of the air pressure.

13. Make a final visual inspection to make sure cables and other parts are not interfering with tire rotation or up and down fork travel.

☐ Have your instructor check your work.

14. Clean up area and return tools and materials to proper storage.

WHEELS AND TIRES
UNIT X

JOB SHEET #2 — REMOVE, REPLACE/REPAIR, AND INSTALL A REAR TIRE AND WHEEL ASSEMBLY ON A MOTORCYCLE

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Torque wrench
6. Pencil
7. Safety glasses

B. Routine #1 — Removing a chain or belt-driven rear wheel

1. Put on safety glasses.
2. Raise the rear wheel of the motorcycle and support the motorcycle firmly so it cannot fall.
3. Loosen the drive chain (or belt) adjusting lock nuts and bolts. (Figure 1)

FIGURE 1

4. Remove the rear brake caliper, if required.

JOB SHEET #2

5. Disconnect the rear brake cable or rod. (Figure 2)

FIGURE 2

6. Disconnect the rear brake backing plate support. (Figure 3)

FIGURE 3

7. Remove the cotter key from the rear axle nut and then remove the axle nut.

8. Remove the rear axle, if required. (Figure 4)

FIGURE 4

JOB SHEET #2

9. Use a soft face mallet if you have to strike the axle to loosen it, but do not pound the axle with a hard-faced hammer.

   (NOTE: Getting the axle out may require removing the muffler or the entire exhaust system or removing the rear shocks to allow the axle to come out.)

10. Move the rear wheel forward as far as possible and remove the drive chain (or belt). (Figure 5)

FIGURE 5

11. Take special care to notice the position of bushings and spacers, and if you need to, make a note or a sketch of how things are arranged. (Figure 6)

FIGURE 6

12. Remove the rear wheel assembly.

    (NOTE: Getting the wheel off sometimes requires removing the rear fender or lifting a hinged rear fender up.)

13. Remove bushings and spacers so they won't get lost while you're working on the tire.

14. Remove the valve cap and valve core and let the air out of the tire.

JOB SHEET #2

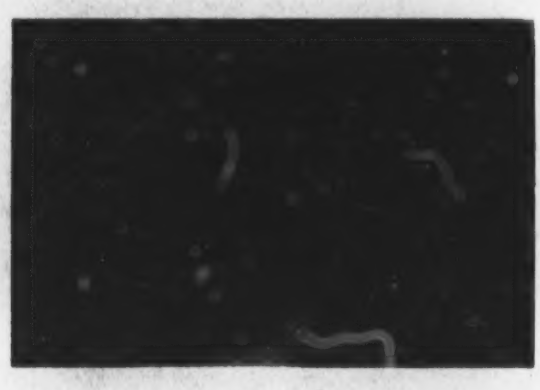
15. Remove the valve stem lock nuts if it is a tube-type tire.

☐ Have your instructor check your work.

C. Routine #2 — Removing a shaft-driven rear wheel

1. Put on safety glasses.
2. Raise the rear wheel of the motorcycle and support the motorcycle firmly so it cannot fall.
3. Remove the rear brake caliper, if required.
4. Disconnect the rear brake cable or rod.
5. Disconnect the rear brake backing plate.
6. Remove the cotter key from the rear axle nut and remove the rear axle nut.
7. Remove the rear axle. (Figure 7)

FIGURE 7



8. Use a soft face mallet if you have to strike the axle to loosen it, but do not pound on the axle with a hard-faced hammer.

   (NOTE: Getting the axle out may require removing the muffler or the entire exhaust system or removing the rear shocks to allow the axle to come out.)

JOB SHEET #2

9. Take special care to notice the position of bushings and spacers, and if you need to, make a note or a sketch of how things are arranged. (Figure 8)

FIGURE 8

10. Work the tire back and forth and disengage it from the drive splines. (Figure 9)

FIGURE 9

11. Remove the rear wheel assembly. (Figure 10)

(NOTE: Getting the wheel off sometimes requires removing the rear fender or lifting a hinged rear fender up.)

FIGURE 10

JOB SHEET #2

12. Remove bushings and spacers so they won't get lost while you're working on the tire.

13. Remove the valve cap and valve core and let the air out of the tire.

14. Remove the valve stem lock nuts if it is a tube-type tire.

☐ Have your instructor check your work.

D. Routine #3 — Installing a chain or belt-driven rear wheel

1. Leave your safety glasses on.

2. Recheck the air pressure in the tire.

3. Review your notes or sketch made when you took the rear wheel off, and put the bushings and spacers back into the rear hub in their proper locations.

4. Position the wheel assembly in the swing arm, align components, and slide the axle through.

5. Start the axle nut onto its threads.

6. Slide the tire and wheel assembly forward as far as possible and place the chain or belt on the sprocket.

7. Reconnect the backing plate support.

8. Reconnect the rear brake cable or rod or replace the rear brake caliper, and torque all bolts to values outlined in the service manual.

   (NOTE: Be sure to replace all locking devices that were removed during disassembly.)

9. Adjust the chain or drive belt to specifications in the service manual.

   (NOTE: Check the service manual for proper adjustment because some procedures require that a rider be on the bike or the suspension be depressed.)

10. Tighten the axle to torque values in the service manual.

11. Replace the cotter key in the axle.

12. Spin the rear wheel to make sure it runs straight and true and doesn't bind.

13. Pump the rear brakes to seat the brake pads.

☐ Have your instructor check your work.

14. Clean up the area and return tools and equipment to proper storage.

JOB SHEET #2

E. Routine #4 — Installing a shaft-driven rear wheel

1. Leave your safety glasses on.
2. Recheck the air pressure in the tire.
3. Review your notes or sketch made when you took the rear wheel off, and put the bushings and spacers back into the rear hub in their proper locations.
4. Grease the final drive splines with waterproof grease.
5. Position the wheel assembly in the swing arm, align components, and slide the axle through.
6. Start the axle nut onto its threads.
7. Reconnect the rear brake baking plate support.
8. Loosen the final drive flange bolts, if needed, and then tighten the axle to torque values in the service manual.
9. Install the cotter key in the axle nut.
10. Retighten the final drive flange bolts, if needed.
11. Replace the rear brake caliper or brake rod or cable and torque to specifications in the service manual.

    (NOTE: Be sure to replace all locking devices that were removed during disassembly.)
12. Spin the rear wheel to make sure it runs straight and true and doesn't bind.
13. Pump the rear brake to seat the brake pads.

☐ Have your instructor check your work.

14. Clean up the area and return tools and materials to proper storage.

WHEELS AND TIRES
UNIT X

JOB SHEET #3 — REPLACE A DAMAGED RIM AND RESPOKE AND TRUE A MOTORCYCLE WHEEL

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Spoke wrench
6. New spokes as required
7. New rim as required
8. Trueing stand
9. Dial indicator
10. Bolt cutters or oxyacetylene cutting torch
11. Pencil
12. Safety glasses

B. Routine #1 — Removing the old rim and spokes

1. Put on safety glasses.
2. Remove the wheel assembly from the motorcycle as outlined in a previous job sheet.
3. Remove the tire as outlined in a previous job sheet.
4. Remove the sprocket and brake rotors as required.

JOB SHEET #3

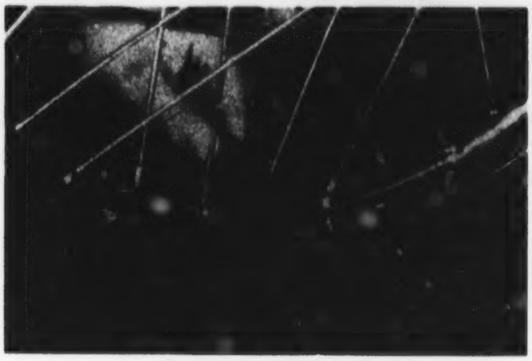
5. Install the wheel assembly in a trueing stand. (Figure 1)

FIGURE 1

6. Make a sketch of the spoke pattern.

7. Loosen all spoke nipples with a spoke wrench. (Figure 2)

FIGURE 2

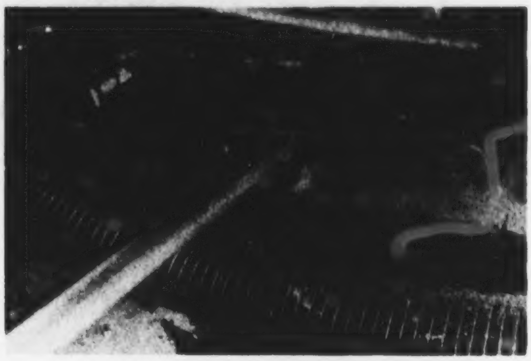


JOB SHEET #3

8. Remove the spoke nipples with a screwdriver. (Figure 3)

   (NOTE: It it's an old wheel, removing the nipples is virtually impossible, and the fastest way to remove them is with a cutting torch or bolt cutters.)

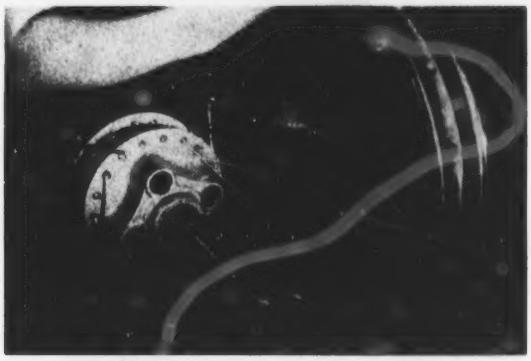
   FIGURE 3



9. Support the rim so it won't fall as you remove the last few spoke nipples.

10. Disengage the rim from the spokes and remove the rim and lay it aside. (Figure 4)

    FIGURE 4



11. Remove all spokes from the hub.

☐ Have your instructor check your work.

C. Routine #2 — Replacing the rim and spokes

1. Leave your safety glasses on.

   (NOTE: This routine assumes that you are working on a wheel that has spokes that are all the same length.)

JOB SHEET #3

2. Separate the spokes into inner and outer spokes. (Figure 5)

FIGURE 5

3. Identify inner spokes by looking for a less than 90° bend on the end of the spoke. (Figure 6)

4. Identify outer spokes by looking for a more than 90° bend on the end of the spoke. (Figure 6)

FIGURE 6

5. Install all the spokes in the hub in alternating inner/outer positions, first on one side of the hub and then the other. (Figure 7)

FIGURE 7

JOB SHEET #3

6. Install the spokes into the rim with the following procedure:

   a. Note how the holes on the rim are divided into patterns of four, and note also the different angles of the inner and outer spokes.

   b. Note that every fifth hole in the rim will be at the same angle and will point in the same direction and will serve as a guide to make the procedure easier.

   c. Find the proper positions for the inner spokes on one side of the rim and put them in first and tighten the nipples a couple of turns. (Figure 8)

   (NOTE: Take care that an outer spoke does not get caught behind an inner spoke or you may have to remove the inner spoke again.)

   FIGURE 8

   d. Find the proper positions for the outer spokes, cross them properly over the inner spokes, and tighten the nipples a couple of turns. (Figure 9)

   FIGURE 9

   e. Go to the other side of the rim and hub and repeat the procedure, and be sure to start with the inner spokes first.

   (NOTE: Spokes will fit in one position only, so if you don't have it right, you'll know immediately because the spoke will be obviously too long or too short.)

JOB SHEET #3

7. Start at the valve stem hole and run the nipples down lightly so that about half the thread is left exposed on each spoke.

8. Check to see if the rim is too loose, and if it is, run the spoke nipples down a couple of more turns to better position the rim over the center of the hub and roughly true the wheel. (Figure 10)

FIGURE 10

☐ Have your instructor check your work.

9. Continue on to Routine #3.

D. Routine #3 — Trueing the wheel

1. Leave your safety glasses on.

2. Position the trueing stand pointer close enough to the rim that it will clearly show lateral and radial runout. (Figure 11)

FIGURE 11

JOB SHEET #3

3. Use a screwdriver to keep running the spoke nipples down until the wheel is fairly round and true.

   (NOTE: As you tighten one spoke it may loosen another spoke, so don't tighten any one spoke excessively and be sure to check for loose spokes often as you move around the rim.)

4. Continue to loosen and tighten spokes as required to get the wheel eyeball straight.

5. Install a dial indicator on the trueing stand pointer, and use your spoke wrench to make remaining adjustments. (Figure 12)

   FIGURE 12

6. Watch the needle on the dial indicator for indications of where lateral adjustment is needed.

7. Make the major adjustments first by adjusting both sides toward the center so that the two adjustments counterbalance each other.

   (NOTE: The idea is to make sure the rim stays centered over the hub.)

JOB SHEET #3

8. Continue to loosen and tighten spokes to get the rim straight. (Figure 13)

   (NOTE: A rim has a bulge in it where it is welded together, and this will show up on the dial indicator, but it won't affect the straightness of the wheel, so don't waste time trying to correct it by tightening or loosening spokes.)

   FIGURE 13

9. Check the wheel for radial runout and tighten or loosen spokes as needed to correct any problem.

   (NOTE: Remember, at this point you're not working with inner or outer spokes to control straightness of the wheel, you're working with combinations of inner and outer spokes to control the roundness of the wheel.)

10. Make a final check for loose spokes and tighten them uniformly.

11. Make another final check with the dial indicator.

12. Make minor adjustments as required.

13. Make sure no spokes protrude through the nipple and into outer part of the rim where they could puncture a tube.

14. Grind off the ends of any spokes that protrude beyond the nipple.

☐ Have your instructor check your work.

15. Clean up the area and return tools and materials to proper storage.

WHEELS AND TIRES
UNIT X

JOB SHEET #4 — REMOVE, REPAIR/REPLACE AND INSTALL A TIRE ON AN ATV

A. Tools and materials

1. ATV as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Torque wrench
6. Tire removing machine/equipment
7. Tire changing lubricant
8. Replacement tire(s) as required
9. Pencil
10. Safety glasses

B. Routine #1 — Removing the tire and wheel assembly

1. Put on safety glasses.
2. Raise the front wheel off the ground, support the ATV so that it cannot fall, and locate and mark the puncture before removing the wheel. (Figure 1)

FIGURE 1

JOB SHEET #4

3. Remove the speedometer cable, if required.
4. Remove the brake caliper(s), if required.
5. Remove the front brake cable, if required.
6. Remove the axle nut cotter key, if required. (Figure 2)

FIGURE 2

7. Remove the axle holders, if required.

   (NOTE: Sketch the markings on the axle holders because they are often directional and have to be replaced the same way they were removed.)

8. Remove the front axle, if required.
9. Use a soft-face mallet if you have to strike the axle to loosen it, but do not pound the axle with a hard-face hammer.
10. Take special care to notice the position of bushings, spacers, and the speedometer drive gear as you remove the axle, and if you need to, make notes or make a sketch of how things are arranged.
11. Remove the front tire.
12. Remove all bushings, spacers, and the speedometer drive gear so they won't get lost while you're working on the tire.
13. Remove the valve cap and valve core and let the air out of the tire. (Figure 3)

FIGURE 3

JOB SHEET #4

14. Remove the valve stem lock nuts if the tire has a tube in it.

    (NOTE: Removing a rear tire requires safely supporting the ATV and removing three to five nuts that hold the wheel to the hub because there are no cables of any kind to remove.)

☐ Have your instructor check your work.

15. Ask your instructor whether you are to complete your job with tire tools or with a tire changing machine:

    a. If you're using tire tools, go on to Routine #2.

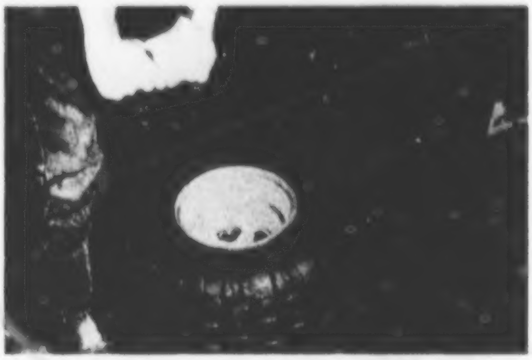
    b. If you're using a tire changing machine, skip to Routine #3.

C. Routine #2 — Changing an ATV tire with tire tools

1. Leave your safety glasses on.

2. Break the tire away from the bead of the rim with a bead breaker. (Figure 4)

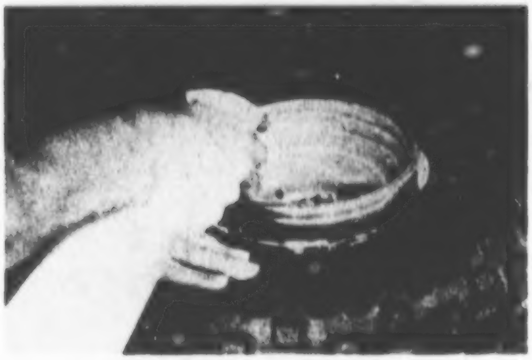
FIGURE 4



3. Place the tire and wheel assembly on a suitable work surface that will allow the assembly to lie flat.

4. Lubricate the tire bead with tire lubricant. (Figure 5)

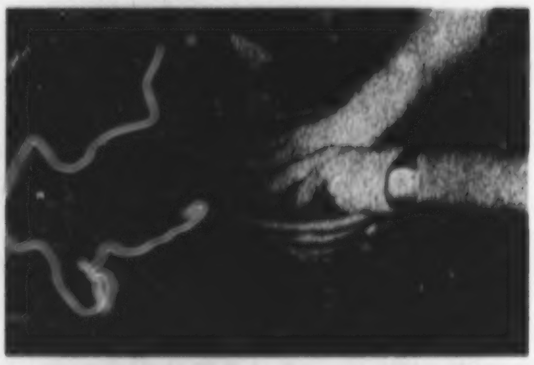
FIGURE 5



JOB SHEET #4

5. Insert the hooked end of a tire tool on one side of the valve stem and insert the straight end of another tire tool on the other side of the valve stem so that the two tire tools are about two inches apart. (Figure 6)

FIGURE 6



6. Pry the bead up and over the rim with both tire tools, making certain that you don't pull the tube up with the bead. (Figure 7)

FIGURE 7

7. Pull the straight-ended tire tool out and move it over about two inches and reinsert it between the bead and the rim.

8. Pry the tire up once more and continue this procedure around the tire until you have that side of the tire completely over the rim. (Figure 8)

FIGURE 8

JOB SHEET #4

9. Remove the tube, if there is one.

10. Turn the tire over on the working surface.

11. Start with the tire tools on either side of the valve stem and move around the tire as you did on side one, but this time pry the bead up and over the same side of the rim as before. (Figure 9)

    (NOTE: Sometimes the tire tool with the straight end has to be installed in line with the bead and then turned at a right angle to get the second side of the tire off, and this is where the rim often gets damaged, so work with care.)

    FIGURE 9

12. Remove the tire completely and set it aside.

13. Inspect the rim for cracks, bends, or nicks that could make further use of the rim dangerous.

14. Clean the seating surfaces of the rim thoroughly with a wire brush, and remove all corrosion or rust.

☐ Have your instructor check your work.

15. Check the tire you intend to put back on the ATV to make sure the bead is free of defects and damage.

16. Check inside the tire for damage or the presence of foreign objects.

17. Check the valve stem, if it is a tubeless tire, and replace it if it is damaged.

18. Check the directional tread on the tire to determine which side of the tire goes on the wheel first and which side of the ATV the tire goes on.

19. Lubricate the beads with rubber lubricant.

JOB SHEET #4

20. Push the first bead onto the rim by hand, and then continue with the hooked end of the tire tool until you get the complete bead on one side of the wheel. (Figure 10)

FIGURE 10

21. Inflate the tube just enough to get all the wrinkles out.

22. Work the tube valve stem in first and start one of the valve stem lock nuts to hold it in place.

23. Work the rest of the tube into the tire and over the rim.

24. Get the tube well up into the central part of the tire so that you won't run the risk of pinching it when you install the other bead.

25. Pick a spot fairly close to either side of the valve stem and insert the hooked end of one tire tool, then move about two inches away, insert the other tire tool and start prying the bead over the rim.

    (NOTE: Don't insert either tire tool deeper than it needs to be or you will pinch or puncture the tube.)

26. Continue working around the tire in small bites until the bead is over the rim. (Figure 11)

FIGURE 11

JOB SHEET #4

27. Take special care with the final area around the valve stem because it may require that you position your tire tools even closer together.

28. Turn the tire slightly one way and then the other to make sure the beads are properly set

    (NOTE: If you're working with a tubeless tire, you may have to install a tube and temporarily inflate it to get the bead to seat, or you can use a seating ring; the tube works better than the ring, but sometimes you have to cut the valve stem off to get the tube in.)

29. Pull the valve stem out and run the lock nut all the way down and lightly tighten it, and make sure the valve stem points straight up.

30. Install the second lock nut over the valve stem and snug it down on the first one.

31. Relubricate the beads with a generous amount of lubricant.

32. Inflate the tire until the beads seat completely on the rim, but do not exceed the maximum bead-seating inflation pressure listed on the tire.

33. Let all the air out of the tire to allow the tube to position itself properly and shake out all the wrinkles.

34. Install the valve core. (Figure 12)

FIGURE 12

35. Inflate the tire to its recommended operating PSI and install a valve cap.

36. Check the tire to make sure there are no bulges or irregularities, and make sure it is seated evenly and firmly around the rim.

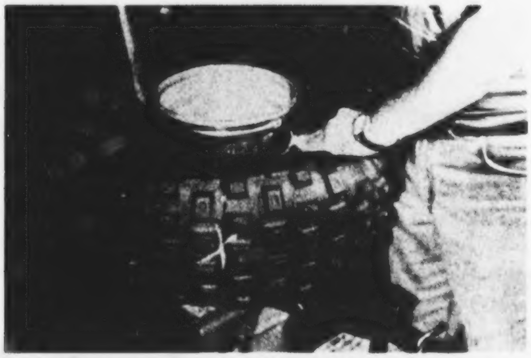
☐ Have your instructor check your work.

JOB SHEET #4

D. Routine #3 — Changing an ATV tire with a tire machine

1. Put on safety glasses.
2. Break the tire away from the bead with a bead breaker.
3. Position the ATV adapter on the tire machine so it will accept the size rim you're working on.
4. Lubricate the top bead of the tire.
5. Place the straight end of the combination tool between the bead of the tire and the rim. (Figure 13)

FIGURE 13



6. Pivot the combination tool over until it lies flat on the wheel, and lower the center post. (Figure 14)

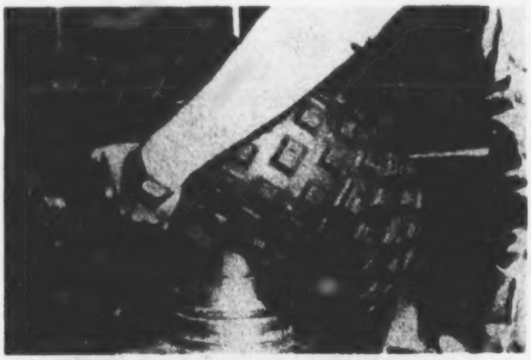
FIGURE 14

7. Pull the combination tool around the rim and remove the top bead of the tire.

JOB SHEET #4

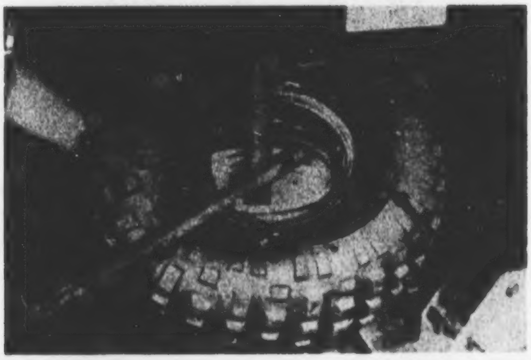
8. Pull the tire up on the rim and install the combination tool underneath the second bead of the tire. (Figure 15)

FIGURE 15



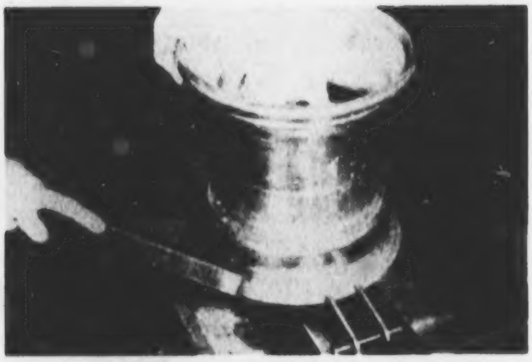
9. Pull the combination tool around the center post and remove the tire from the rim. (Figure 16)

FIGURE 16



10. Inspect the rim for damage, and remove all corrosion or rust with a wire brush. (Figure 17)

FIGURE 17



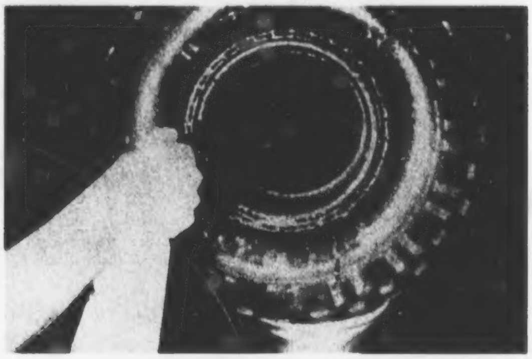
JOB SHEET #4

11. Make any necessary tire repairs.

12. Inspect the tire bead for damage.

13. Lubricate both beads of the tire generously. (Figure 18)

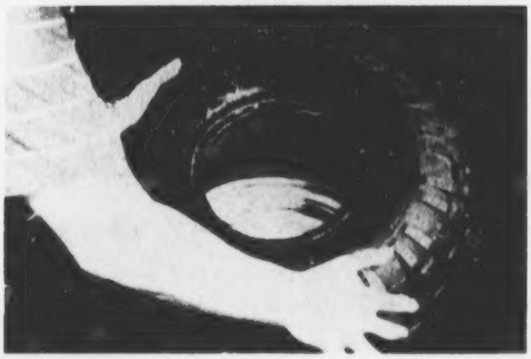
FIGURE 18



14. Check to see if the tire has a directional marking, and place it in the right direction on the rim.

15. Push the first bead of the tire onto the rim by pushing down firmly as you slightly turn the tire to get it over the rim. (Figure 19)

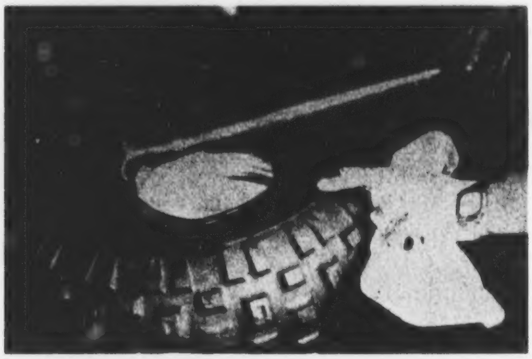
FIGURE 19



JOB SHEET #4

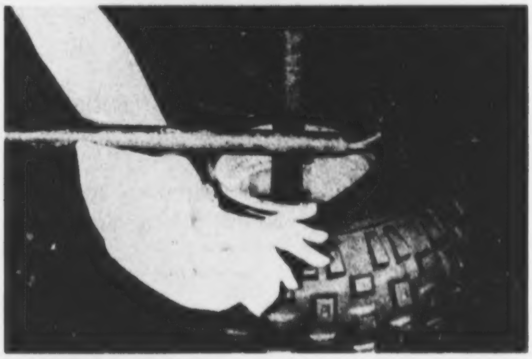
16. Re-lubricate the top bead, if necessary, and place the hooked end of the combination tool between the tire bead and the rim. (Figure 20)

FIGURE 20



17. Lower the center post and pull the combination tool around the rim until the tire bead is completely over the rim. (Figure 21)

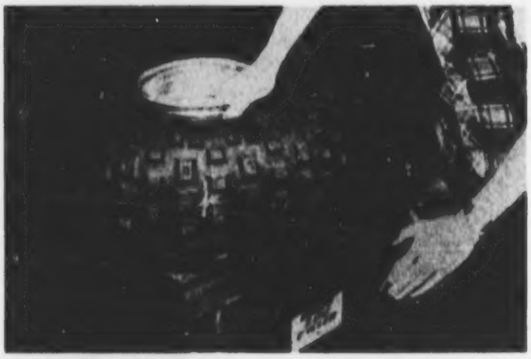
FIGURE 21



18. Be sure to remove the tire from the machine before you attempt to inflate the tire. (Figure 22)

(CAUTION: Inflating the tire while it's on the machine could easily result in rim damage, tire damage, or personal injury.)

FIGURE 22



JOB SHEET #4

19. Inflate the tire until the beads seat, making certain that you do not exceed the maximum bead seating inflation pressure which is stamped on the tire.

    (CAUTION: Over-inflation is extremely dangerous because it can break a rim or worse yet, cause the tire to explode and severely injure the person working on it.)

20. Deflate the tire after it has seated until you reach the normal operating pressure of the tire.

21. Spray soapy water around the rim, valve stem, and patched area to make sure the tire is ready for service.

☐ Have your instructor check your work.

E. Routine #4 — Installing the front wheel

1. Leave your safety glasses on.

2. Recheck the air pressure in the tire to make certain there hasn't been a noticeable pressure loss which would indicate a leak.

   (NOTE: It is not only time consuming but embarrassing to look around and find you have installed a flat tire.)

3. Review your sketch or notes made when you took the front wheel off, and put the bushings, spacers, and speedometer drive gear back into the hub in proper location.

   (NOTE: Take special care with the speedometer drive gear lugs because they must be properly engaged in the slots inside the hub and seated all the way down to avoid damage.)

4. Position the wheel assembly in the front forks and slide the axle through, or install the axle holders as required.

   (NOTE: Axle holders are often directional and must be installed in the same position and direction that they are removed.)

5. Position the speedometer drive gear and reinstall the speedometer cable.

6. Check the service manual for the specified torque for the axle or axle holders and torque to specifications.

7. Install the cotter key and bend the ends to secure it.

8. Reinstall the brake caliper and torque it to specifications in the service manual, if ATV is so equipped, and pump the front brake handle to make sure the brake pads seat properly.

JOB SHEET #4

9. Install the front brake cable and adjust it to specification in the service manual.

10. Spin the wheel to make sure that it runs straight and true and that the bead is seated properly on the rim.

11. Make a final check of the air pressure.

12. Make a final visual inspection to make sure cables and other parts are not interfering with tire rotation or up and down fork travel.

☐ Have your instructor check your work.

WHEELS AND TIRES
UNIT X

JOB SHEET #5 — MAKE INSIDE AND OUTSIDE REPAIRS ON ATV TIRES

A. Tools and materials

1. ATV's as selected by instructor
2. Tire removing machine/equipment
3. Tire changing lubricant
4. Inside tire repair kit with patch
5. Outside tire repair kit with plug
6. Contact cleaner
7. Crayon or chalk
8. Spray tire lubricant
9. Safety glasses

B. Routine #1 — Making an inside repair

1. Put on safety glasses.
2. Remove the ATV tire as outlined in a previous job sheet.
3. Inflate the ATV tire, spray water on it to locate the puncture, and mark the puncture point clearly. (Figure 1)

FIGURE 1

JOB SHEET #5

4. Deflate the tire and dismount it from the rim.

5. Place the tire on a tire spreader or a suitable work surface that will assure ample work room inside the tire.

6. Locate the puncture inside the tire.

7. Clean around the puncture an area about twice the size of the patch you intend to use.

   a. If the puncture is in a ribbed area, you may need to buff the area flat with a buffing tool. (Figure 2)

FIGURE 2

   b. If the tire has ever had a sealer applied inside the tire, you will have to scrape away the sealer with a scraping tool. (Figure 3)

FIGURE 3

JOB SHEET #5

8. Clean the prepared area with a suitable rubber cleaner or contact cleaner so it will be totally clean and dry. (Figure 4)

FIGURE 4

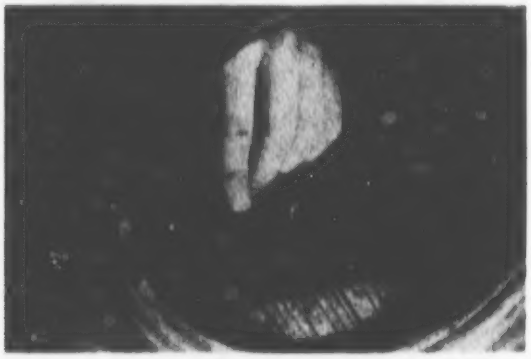
9. Apply a very thin coating of rubber cement to the cleaned area, and allow it to completely dry. (Figure 5)

FIGURE 5

10. Remove carefully the protective covering from the patch, and avoid touching the adhesive surface of the patch.

11. Center the patch over the puncture so that it lies flat and has no wrinkles. (Figure 6)

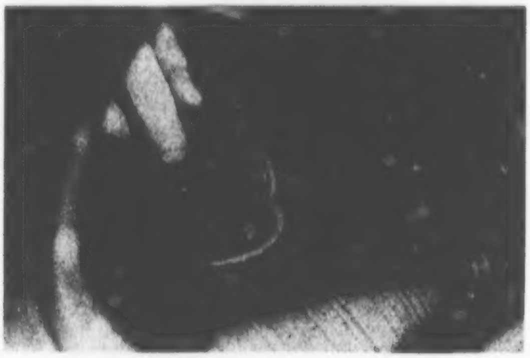
FIGURE 6



JOB SHEET #5

12. Roll the patch down firmly onto the tire, working from the center outward with the roller tool until the patch is firmly in place. (Figure 7)

FIGURE 7



13. Replace the tire on the rim, inflate, and check to make sure the patch has sealed the puncture.

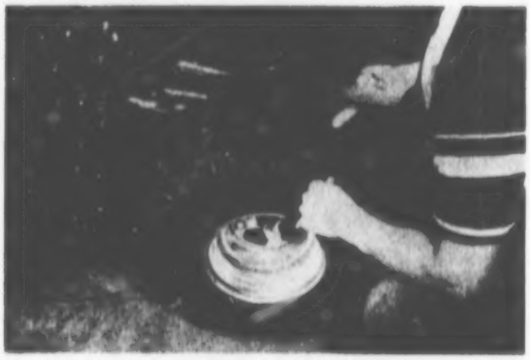
☐ Have your instructor check your work.

C. Routine #2 — Making an outside repair

1. Put on safety glasses.

2. Inflate the tire, locate the puncture, and mark it. (Figure 8)

FIGURE 8



3. Deflate the tire and clean an area around the puncture to avoid contaminating the rubber cement that will be applied.

JOB SHEET #5

4. Clean the puncture with a reaming tool. (Figure 9)

FIGURE 9

5. Dip the reaming tool into the rubber cement until the tool has a liberal amount of cement on it. (Figure 10)

FIGURE 10

6. Push the reaming tool into the puncture so the cement will be applied into and around the puncture. (Figure 11)

FIGURE 11

JOB SHEET #5

7. Select the proper size plug (there are small and large plugs) and attach one end of the plug to the installation tool. (Figure 12)

FIGURE 12

8. Apply a liberal amount of rubber cement to the entire plug. (Figure 13)

FIGURE 13

9. Push the plug immediately into the puncture until about half of the plug remains outside the tire. (Figure 14)

(NOTE: Work quickly because the cement must not be dry when the plug goes into the puncture.)

FIGURE 14

JOB SHEET #5

10. Remove the installing tool, and allow the cement to dry in the puncture and around the plug.

11. Cut the exposed plug off so that no more than 5 mm of the plug remains. (Figure 15)

FIGURE 15

12. Inflate the tire to its operating pressure. (Figure 16)

FIGURE 16

13. Check to make sure the plug has sealed the puncture.

☐ Have your instructor check your work.

14. Clean up area and return tools and materials to proper storage.

WHEELS AND TIRES
UNIT X

PRACTICAL TEST #1
JOB SHEET #1 — REMOVE, REPLACE/REPAIR, AND INSTALL A FRONT TIRE AND WHEEL ASSEMBLY ON A MOTORCYCLE

Student's name ________________________ **Date** __________

Evaluator's name ________________________ **Attempt no.** _____

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed front wheel with proper procedure.	2.	☐	☐
3. Changed a tire with tire tools.	3.	☐	☐
4. Changed a tire with a tire changing machine.	4.	☐	☐
5. Installed the front wheel with the proper procedure.	5.	☐	☐
6. Cleaned area and returned tools to storage.	6.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

WHEELS AND TIRES
UNIT X

PRACTICAL TEST #2
JOB SHEET #2 — REMOVE, REPLACE/REPAIR, AND INSTALL A REAR TIRE AND WHEEL ASSEMBLY ON A MOTORCYCLE

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed a rear wheel with proper procedure.	2.	☐	☐
3. Installed a chain with the proper procedure.	3.	☐	☐
4. Replaced a rear wheel with proper procedure.	4.	☐	☐
5. Cleaned area and returned tools to storage.	5.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

WHEELS AND TIRES
UNIT X

PRACTICAL TEST #3
JOB SHEET #3 — REPLACE A DAMAGED RIM AND RESPOKE AND TRUE A MOTORCYCLE WHEEL

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed old rim and spokes properly.	2.	☐	☐
3. Replaced rim and spokes with correct procedure.	3.	☐	☐
4. Used trueing equipment properly to correct radial and lateral runout.	4.	☐	☐
5. Cleaned area and returned tools to storage.	5.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #3 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

WHEELS AND TIRES
UNIT X

PRACTICAL TEST #4
JOB SHEET #4 — REMOVE, REPAIR/REPLACE AND INSTALL A TIRE ON AN ATV

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed tire and wheel assembly with proper procedure.	2.	☐	☐
3. Changed an ATV tire properly with tire tools.	3.	☐	☐
4. Changed an ATV tire properly with a tire changing machine.	4.	☐	☐
5. Remounted tire properly.	5.	☐	☐
6. Replaced wheel assembly properly.	6.	☐	☐
7. Cleaned area and returned tools to storage.	7.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #4 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

WHEELS AND TIRES
UNIT X

PRACTICAL TEST #5
JOB SHEET #5 — MAKE INSIDE AND OUTSIDE REPAIRS ON ATV TIRES

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed tire properly and marked puncture.	2.	☐	☐
3. Made proper inside repair.	3.	☐	☐
4. Remounted tire with proper procedure.	4.	☐	☐
5. Marked puncture on second tire.	5.	☐	☐
6. Made proper outside repair.	6.	☐	☐
7. Checked tires properly for leaks.	7.	☐	☐
8. Cleaned area and returned tools to storage.	8.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #5 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

WHEELS AND TIRES
UNIT X

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. Legally obligated to assume responsibility for product malfunctions or for improper repairs that endanger persons or property

_____b. Motorcycles that generally are not licensed for use on streets or highways, but rather in motocross racing or general pleasure riding

_____c. Motorcycles that are designed for licensed use on public streets and highways

_____d. A metal valve stem that will not weather or wear out

_____e. A form of tire and rubber valve deterioration caused by exposure to sun, wind, and rain

_____f. A short rubber valve installed in a rim to permit inflation and deflation of a tire

_____g. A spring-loaded device inserted into a valve stem to turn the valve stem into a one-way valve that will permit air to enter but will not permit air to escape

_____h. A rubber ring that can be installed between the rim and one bead of a tubeless ATV tire to provide a temporary seal on one side of the tire and help seat the tire as it is inflated

1. Off-road motorcycles
2. Valve stem
3. Seating ring
4. Liable
5. Valve core
6. Weather cracks
7. Lifetime valve stem
8. Street bikes

2. Complete statements concerning types of wheels by inserting the word(s) that best completes each statement.

a. Spoke wheels are fastened to the ____________ by spokes and require periodic inspection and maintenance.

b. Mag wheels are made mostly of ____________, are practically maintenance free, and have a modern look that enhances the appearance of a motorcycle.

c. Extruded wheels usually have three pieces, are either spoke or mag-type riveted to a rim, and are popular because of their ____________ weight.

TEST

d. Tube-type wheels are usually ____________ wheels and are used primarily for off-road applications.

e. Tubeless wheels are used primarily on ____________ bikes because they run cooler and require less service.

f. Bead-lock wheels are used with tubeless tires on ____________ because extremely low tire pressures are used and the bead lock keeps the tire on the rim.

3. Match parts of a tire with their characteristics.

_____a. The steel-reinforced inner circle on a tire that seats onto the rim

_____b. A tire that has a cord body that runs straight around the tire from one bead to the other and is covered with a belt that runs around the circumference of the tire underneath the tread

_____c. A tire that has a cord body that runs diagonally from one bead to the other and may use several plies

_____d. The part of a tire that extends from the bead to the tread

_____e. The outer part of the tire that contacts the road with grooves designed to shed water and grip the road

1. Bias-ply
2. Tread
3. Bead
4. Radial-ply
5. Sidewall

4. Complete statements concerning tire tools and equipment by inserting the word(s) that best completes each statement.

a. The Coats 200/220 motorcycle tire changer is probably the ____________ ____________ piece of equipment in tire service.

b. A wheel balancer is used on almost all tire changes to insure longer tire life and ____________

c. A bubble balancer works with a bubble like the bubble in a carpenter's level, but a dynamic balancer is ____________ to locate areas on the tire where weight is required and how much weight is required.

d. A tire tool is a slim, flat tool spoon-shaped on one end and straight on the other so it can be used to ____________ the tire off the rim.

e. ATV bead breakers come in several different designs, but all of them are built to help remove an ATV tire from a bead-lock rim without ____________ either the tire or the rim.

TEST

f. A __________ __________ installing tool is used to install a rubber valve stem in a tubeless wheel, and the tool helps prevent damage to the valve stem during installation.

g. A __________ __________ gauge is used to measure ATC tire pressures which may range from half a pound to about 5 pounds, and a high pressure gauge is used for all other tires.

5. Complete a list of other supplies required for tire repair by inserting the word(s) that best completes each statement.

   a. Tubeless and ATV tire repair __________

   b. Rubber __________ to prevent damage to the bead of the tire and to insure proper seating of the bead

   c. Tubeless valve __________

   d. A valve __________ removing tool

   e. __________ caps

   f. Chalk or grease pencil to mark __________ locations

6. Solve the following problems concerning tire markings.

   a. While installing a tire, you notice a white zero painted on the sidewall; what does the marking mean, and how should it affect your tire installation?

      Answer ____

      ____

   b. You are getting ready to mount a tire and notice that it has an arrow stamped on the sidewall; what does the arrow mean, and how should it affect your tire mounting?

      Answer ____

      ____

7. Complete statements concerning valve stems and valve caps by inserting the word(s) that best completes each statement.

   a. When installing a __________ tire, a new valve stem should be installed unless the valve stem is a metal lifetime stem.

   b. A valve stem must be seated all the way to the seating flange and should always be checked to make sure it was not __________ during installation.

TEST

c. When first inflating a tubeless tire, it requires a great volume of air and the valve core usually has to be ____________ to get a sufficient air supply into the tire.

d. After initial inflation of a tube, the valve core should be ____________ to deflate the tube and permit it to adjust to the tire and free itself of wrinkles.

e. Always place a ____________ ____________ on the valve stem to protect the valve core from mud and water.

8. Select true statements concerning tubeless tire repair by placing an "X" beside each statement that is true.

_____a. Always locate and mark puncture locations before removing a tire.

_____b. Tubeless tire repair is generally not recommended, but is acceptable if the tire is repaired with a permanent plug patch.

_____c. The plug patch is installed from outside the dismounted tire and consists of one-piece plug that goes through the puncture and an attached plug cap which is sealed to the outer tread of the tire.

_____d. Plug patches should be used only on small punctures that are in the tread area of the tire and never on punctures in the sidewall.

_____e. It is not recommended to install a tube in a tubeless tire on a wheel that is designed for a tubeless tire because the rough inside of the rim will rub a hole in the tube and could cause overheating problems too.

9. Complete statements concerning tire liabilities by inserting the word(s) that best completes each statement.

a. If a new tire in a street bike tire goes bad, the manufacturer might be liable if it results in injury, but if a patched tube goes bad, the dealership could be liable, so the rule is to ____________ patch a tube.

b. Never install a tire sized above or below what the manufacturer recommends because an ____________ tire could rub the frame and an ____________ tire won't handle the load.

c. Some tires are specified for use with only certain ____________ of motorcycles and should not be used on any other vehicles.

d. Tires marked ____________ should be used only on a rear wheel, and tires marked ____________ should be used only on a front wheel.

e. When a tire has directional arrows on it, it should be mounted with the arrows moving in the direction of ____________ rotation.

f. A new front tire matched with a worn rear tire will result in instability, and the customer should be encouraged to install a ____________ set.

g. After mounting, wash all tires with water and a brush to assure that the slick residue left from manufacturing or lubricants used in mounting are totally removed because the combination of the two can cause a tire to ____________ out of control.

TEST

h. After the tire is installed on the motorcycle, spin the tire to make certain that the bead is seated on the rim and that the tire runs ____________ and ____________.

i. Check spoked wheels for ____________ or ____________ spokes and tighten or replace as needed before mounting a new or used tire.

10. Match spoke and rim terms with their meanings.

_____a. A metal rod that attaches the rim of the wheel to the hub of the wheel

_____b. A long nut that goes through the rim and screws onto the spoke to secure it to the rim

_____c. The round metal part of the wheel that the tire fits on to

_____d. The small or recessed part of the rim that allows enough clearance for the bead of the tire to be removed from the rim

_____e. The center of the wheel assembly that contains the wheel bearings and the brake drum or rotor, and has holes in it for attaching spokes

_____f. A strip of rubber that goes around the rim to protect the tube from the spoke nipples

_____g. A spoke that extends from the inside of the hub to the rim and has more than a 90° bend at the spoke head

_____h. A thick, special design wrench for tightening or loosening spokes

1. Hub
2. Spoke wrench
3. Rim liner
4. Outer spoke
5. Spoke
6. Inner spoke
7. Drop center
8. Rim
9. Spoke nipple

11. Match wheel trueing terms with their meanings.

_____a. The degree to which a wheel wobbles back and forth as it turns

_____b. The degree to which a wheel moves up and down from a center axle as it turns

_____c. A phrase used to indicate the combination of lateral runout which is straight and radial runout which is true

_____d. A precision measuring tool that accurately measures lateral runout so it can be straightened

1. Trueing stand
2. Straight and true
3. Lateral runout
4. Pointer
5. Dial indicator
6. Radial runout

TEST

_____e. A stand with an axle that goes through a hub to securely mount a wheel assembly for convenient access by a technician

_____f. A metal rod that attaches to a trueing stand in such a way that it can be used as a reference point for checking lateral and radial runout and also serves as a mounting base for the dial indicator

12. Select true statements concerning spoke patterns by placing an "X" beside each statement that is true.

_____a. All spoke patterns cross in some fashion to give the rim strength and stability.

_____b. A cross-one spoke pattern means that a spoke must cross one other spoke on the same side that is going in the opposite direction.

_____c. A cross-two spoke pattern means that a spoke must cross two other spokes on the same side that are going in the opposite direction, and a cross-two pattern is the most common.

_____d. A cross-three pattern means that a spoke must cross three other spokes on the same side that are going in the opposite direction.

_____e. The number of spokes that a wheel contains will always be in multiples of three, and 30 is the most common.

13. Complete a list of guidelines for spoking and trueing wheels by inserting the word(s) that best completes each statement.

a. _____________ spokes are almost never reused because they are _____________, the threads are _____________, and the threads are usually _____________.

b. Since old spokes are of no further use, the fastest way to remove them is with a _____________ _____________ or _____________ cutters.

c. If a spoked wheel is noticeably bent, it cannot be straightened and should be replaced for _____________ reasons.

d. Always be careful to never overtighten spokes because they could ruin the _____________ and break the spoke.

e. Off-road wheels don't have to run as true as street-bike wheels, but both should run straight and true, and if there is any doubt, the wheel should be checked in a wheel-trueing stand with a _____________ indicator.

f. Specifications for trueing a wheel are almost always found in the appropriate _____________ manual.

TEST

14. Complete statements concerning ATV tires by inserting the word(s) that best completes each statement.

    a. The popularity of all terrain vehicles has made ATV ____________ ____________ an important part of motorcycle service.

    b. The most difficult part of servicing an ATV tire is breaking the ____________ away from the ____________.

    c. ATV wheels are so small that they're difficult to hold unless they are secured in a ____________ ____________ ____________.

    d. Mounting ATV tires requires liberal use of tire ____________.

    e. The wide rims make it difficult to seat the bead initially so the tire can be aired up, and sometimes a tube has to be placed inside the tire and inflated enough to seat one bead, then ____________ and ____________.

    f. ATV tires can frequently be repaired from the ____________ without being dismounted.

    g. ATV tires are sometimes directional because of tread pattern, but they do not have directional arrows so you have to pay special attention to ____________ and ____________ ____________ tires.

    h. Always keep ATV tire pressure within the ____________ pressure limits specified.

    i. Rear tires have to be the same diameter, and this may require ____________ air pressure to compensate for a tire that has been stretched.

15. Complete statements concerning personal safety around wheels and tires by inserting the word(s) that best completes each statement.

    a. Before mounting a new tire, inspect the wheel for cracks or damage because if the wheel is bad there is no need to mount the tire and it poses a danger of ____________ during inflation.

    b. Never attempt to seat the bead on a tire by ____________ the tire ____________ the recommended seating pressure stamped on the tire.

    c. Because sprockets are sharp and can cause severe injuries, remove tires from the ____________ side of the sprocket, and remove a sprocket if it will not fit into a ____________ ____________.

    d. Before you test drive a motorcycle after tire replacement, make sure the ____________ are working properly.

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

16. Demonstrate the ability to:

    a. Remove, replace/repair, and install a front tire and wheel assembly on a motorcycle. (Job Sheet #1)

    b. Remove, replace/repair, and install a rear tire and wheel assembly on a motorcycle. (Job Sheet #2)

    c. Replace a damaged rim and respoke and true a motorcycle wheel. (Job Sheet #3)

    d. Remove, replace/repair, and install a tire on an ATV. (Job Sheet #4)

    e. Make inside and outside repairs on ATV tires. (Job Sheet #5)

WHEELS AND TIRES
UNIT X

ANSWERS TO TEST

1. a. 4
   b. 1
   c. 8
   d. 7
   e. 6
   f. 2
   g. 5
   h. 3

2. a. Hub
   b. Aluminum
   c. Light
   d. Spoked
   e. Street
   f. ATV's

3. a. 3
   b. 4
   c. 1
   d. 5
   e. 2

4. a. Most used
   b. Safety
   c. Computerized
   d. Pry
   e. Damaging
   f. Valve stem
   g. Low pressure

5. a. Kits
   b. Lubricant
   c. Stems
   d. Core
   e. Valve
   f. Puncture

6. a. The marking is a balance mark, and it should be lined up with the valve stem when the tire is installed
   b. The arrow means it is a directional tire, and it should be installed so that the arrow points in the same direction as the wheel rotates when the bike is moving

7. a. New
   b. Damaged
   c. Removed
   d. Removed
   e. Valve cap

8. a, b, d, e

ANSWERS TO TEST

9. a. Never
   b. Oversize, undersize
   c. Models
   d. "Rear," "Front"
   e. Forward
   f. Matched
   g. Slide
   h. Straight, true
   i. Loose, missing

10. a. 5
    b. 9
    c. 8
    d. 7
    e. 1
    f. 3
    g. 6
    h. 4
    i. 2

11. a. 3
    b. 6
    c. 2
    d. 5
    e. 1
    f. 4

12. a, b, c, d

13. a. Old, stretched, rusted, damaged
    b. Cutting torch, bolt
    c. Safety
    d. Hub
    e. Dial
    f. Service

14. a. Tire repair
    b. Bead, rim
    c. Tire changing machine
    d. Lubricant
    e. Deflated, removed
    f. Outside
    g. Right, left hand
    h. Low
    i. Unequal

15. a. Exploding
    b. Inflating, beyond
    c. Opposite, tire changer
    d. Brakes

16. Performance skills evaluated by practical tests

STEERING AND SUSPENSION SERVICE
UNIT XI

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify front fork components and discuss service procedures for the steering assembly. The student should also be able to discuss requirements for final drive service, change oil in a front fork, replace front fork seals, change final drive oil, replace drive chain and sprockets, and adjust steering head bearings. These competencies will be evidenced by correctly completing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to steering and suspension service with their correct definitions.
2. Match front fork components with their functions.
3. Complete statements concerning front fork fluid.
4. Complete statements concerning steering head bearings.
5. Select true statements concerning swing arm pivot assemblies.
6. Complete statements concerning sprockets and chain drives.
7. Complete statements concerning belt drives.
8. Complete statements concerning drive shafts.
9. Demonstrate the ability to:
    a. Change oil in a front fork. (Job Sheet #1)
    b. Replace front fork seals. (Job Sheet #2)
    c. Change final drive oil. (Job Sheet #3)
    d. Inspect and replace drive chain and sprockets. (Job Sheet #4)
    e. Inspect and adjust steering head bearings. (Job Sheet #5)

STEERING AND SUSPENSION SERVICE
UNIT XI

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Discuss the importance of suspension and improvements that are important to rider safety and comfort.

H. Show examples of worn sprockets and chains, and discuss the danger of operating a bike with worn sprockets and chains.

I. Demonstrate the correct procedure for removing a fork seal and impress upon students the necessity for not damaging the fork seal housing.

J. Demonstrate the procedure for removing the allen bolt from the bottom of a fork leg.

K. Demonstrate how to place a fork leg in a vise so that the leg will not be damaged or scratched.

L. Demonstrate how to correctly install a fork cap without damaging the threads.

M. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Hires, Bill, Mark Taylor, and Mike Bundy. *Small Engine Repair Two-Stroke and Four-Stroke Cycle.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1985.

C. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics.* New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

D. Johns, Bruce A., and David D. Edmundson. *Motorcycles Fundamentals, Service, Repair.* South Holland, IL: The Goodheart-Willcox Co., Inc., 1984.

E. *Honda Shop Manual '78-'81 CB/CM400's.* Gardena, CA: American Honda Motor Co., Ltd., 1980.

STEERING AND SUSPENSION SERVICE
UNIT XI

INFORMATION SHEET

I. **Terms and definitions**

A. Dampening — A way of controlling abrupt suspension movements with oil pressure directed through restricting oil passages

B. Timpken bearing — A tapered roller bearing

C. Bearing race — The part of a bearing that the rollers or balls fit into

D. Spring preload — The degree of pressure by which a spring is compressed or extended in a fixed state

E. Viscosity — The capacity of an oil to flow in relation to its thickness or thinness, usually expressed in terms of weight with higher numbers designating thicker oils

F. Endless chain — A chain without a master link

II. **Front fork components** (Transparency 1)

A. Upper fork tube — The stationary part of the front fork assembly that fits into the upper and lower bridges of the steering assembly and contains small oil-restricting passages

B. Lower fork tube — Fits over the upper fork tube and is the part of the front fork assembly that the front wheel attaches to, and slides up and down on the upper fork tube to cushion impact

(NOTE: Because the lower fork tube slides up and down, it is sometimes called a slider.)

C. Piston — A tube that has a top sealing ring that attaches to the slider on the bottom end and fits inside the upper fork tube and controls oil movement in and out of oil passages in the upper fork tube (also called a damper rod)

D. Main fork tube spring — Provides the vertical tension needed to support the motorcycle

E. Rebound spring — Provides a cushion for the forks when they are suddenly extended to their fullest

F. Dust seal — A rubber cover that goes on top of the lower fork tube to protect the seal from dirt and water

INFORMATION SHEET

G. Fork seal — A double or triple-lipped high pressure seal that seals the oil in the lower fork tube

H. Bridges — Upper and lower triple clamps that attach to the motorcycle frame and both front forks

I. Stem — A common axle that hooks the lower and upper bridges together

III. **Front fork fluid**

A. Front fork fluid is an oil that comes in different viscosities just like engine oil.

B. Fork oil is available in 5W, 10W, 15W, and 20W.

C. Selection of the proper fork oil viscosity should always be according to specifications in the service manual because forks are designed for specific oils and specific use.

D. Fork oil is the dampening fluid that restricts up and down impact and rebound movement of the front forks and shocks.

E. The heavier the oil, the more resistance to free movement there will be.

F. If front fork fluid has a white or milky color when it is drained, it indicates the presence of water and means that the front fork seals are leaking and should be replaced.

IV. **Steering head bearings**

A. There are two kinds of steering head bearings:

1. Loose ball bearings

2. Tapered roller bearings

B. Loose ball bearings fit between an upper and a lower race and permit free turning between two load bearing components.

C. Tapered roller bearings fit into a tapered bearing race; steering free movement can be restricted according to the torque applied to the steering head adjustment nut.

D. When loose bearings are replaced, their races should also be replaced.

INFORMATION SHEET

V. **Swing arm pivot assemblies** (Transparency 2)

  A. Swing arm pivot assemblies anchor the swing arm so it can move up and down.

  B. There are three basic types of pivot assemblies:

    1. One type consists of bushings with a long pin or bolt that goes all the way through the assembly.

    2. Another type of pivot has needle bearings in place of the bushings, and uses a long pin that goes all the way through to secure the assembly.

    3. Another pivot type uses short bolts that are screwed into the frame from each side and have a pin on the end that fits into a tapered roller bearing which is housed in the swing arm.

  C. The bushing type pivots are used on small street and off-road bikes while the needle bearing type is used on racing bikes, and the tapered roller pivots are used on large street bikes.

VI. **Sprockets and drive chains**

  A. The final drive on some motorcycles consists of:

    1. A counter shaft sprocket or drive sprocket

    2. A rear sprocket or driven sprocket

    3. A drive chain which connects the two sprockets

  B. A worn rear sprocket will almost always indicate that the other sprocket and chain are probably worn and should be replaced.

  C. Both sprockets and the chain should be replaced at the same time because replacing only the chain or only a sprocket will result in rapid wear to the single new component.

  D. In a chain with a master link, the master link will be the weakest link, and when this type of chain breaks, it is usually the master link that breaks.

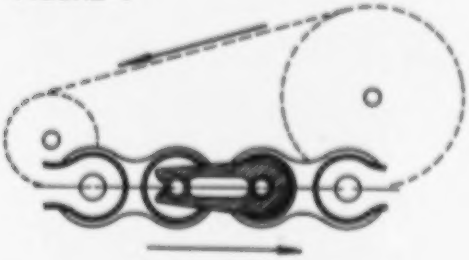
  E. Master links can be replaced in chains that are still serviceable.

  F. Endless chains are more popular on larger displacement motorcycles because they are stronger and do not pose the problem of having a weak master link.

INFORMATION SHEET

G. The important part of assembling a master link is to make sure the open end of the clip goes in the opposite direction of chain rotation. (Figure 1)

FIGURE 1



Courtesy Yamaha Motor Corporation, U.S.A.

VII. **Belt drives**

A. The final drive on some motorcycles consists of:

1. A counter shaft pulley with driving lugs cast into the pulley
2. A driven pulley or rear pulley with driving lugs
3. A drive belt which connects the two pulleys which also has lugs on its inner face

B. Worn belts can be replaced without having to replace pulleys.

C. A worn belt can always be identified by:

1. Frayed or damaged edges
2. Cracked or missing lugs
3. Obvious stretching indicated by a loose belt when the rear wheel has been fully adjusted to the rear

   (NOTE: A stretched belt usually results when a belt has been overtightened or if a pulley is misaligned.)

INFORMATION SHEET

VIII. **Drive shafts**

A. The final drive on some motorcycles consists of:

1. A right-angle gear set to transfer torque from the engine to the drive shaft

   (NOTE: Engines with crankshafts that run in-line with the frame do not use the right-angle gear set.)

2. A drive shaft to transmit torque to the final drive

3. A final drive consisting of a right-angle ring-and-pinion gear

B. Engine oil lubricates most front gear sets, but sometimes they're isolated from the engine oil and the oil has to be changed in the gear housing as specified.

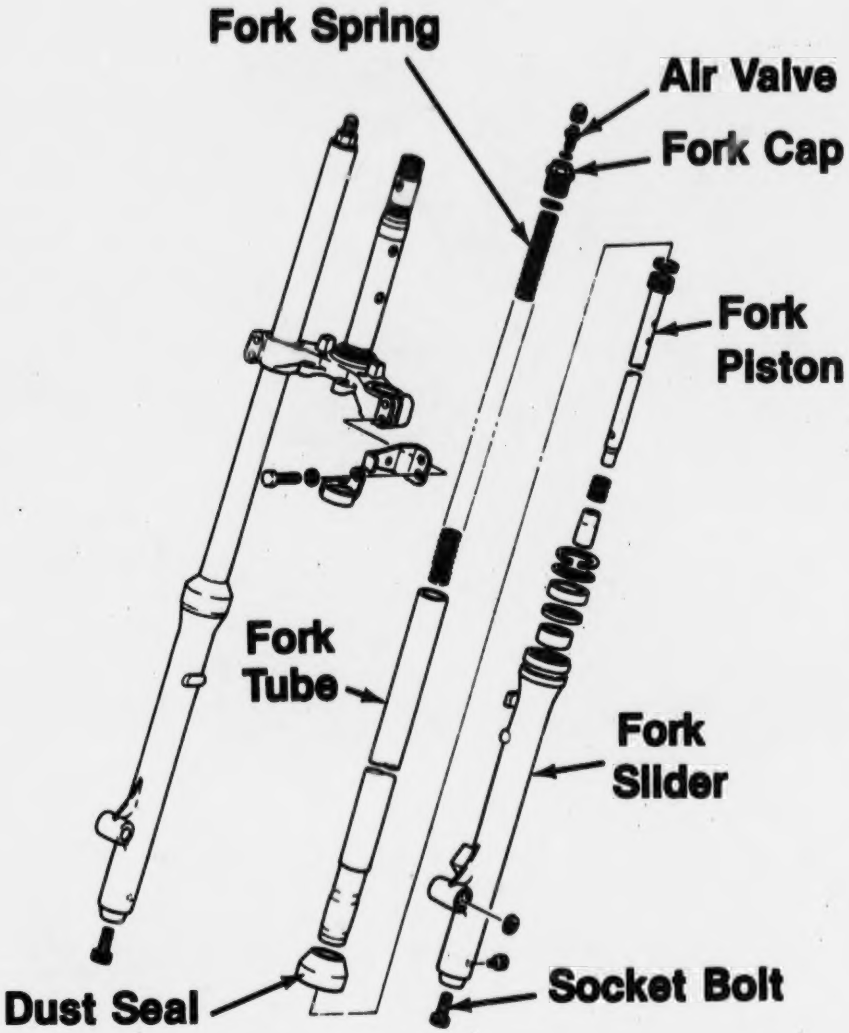
C. The drive shaft has a universal joint, usually at the engine end, and very seldom requires service or replacement.

D. The final drive gear set changes the rotation of the drive shaft 90° and is splined to the rear wheel.

E. The final drive gear set is usually lubricated with a special lubricant which must be changed periodically according to specifications.

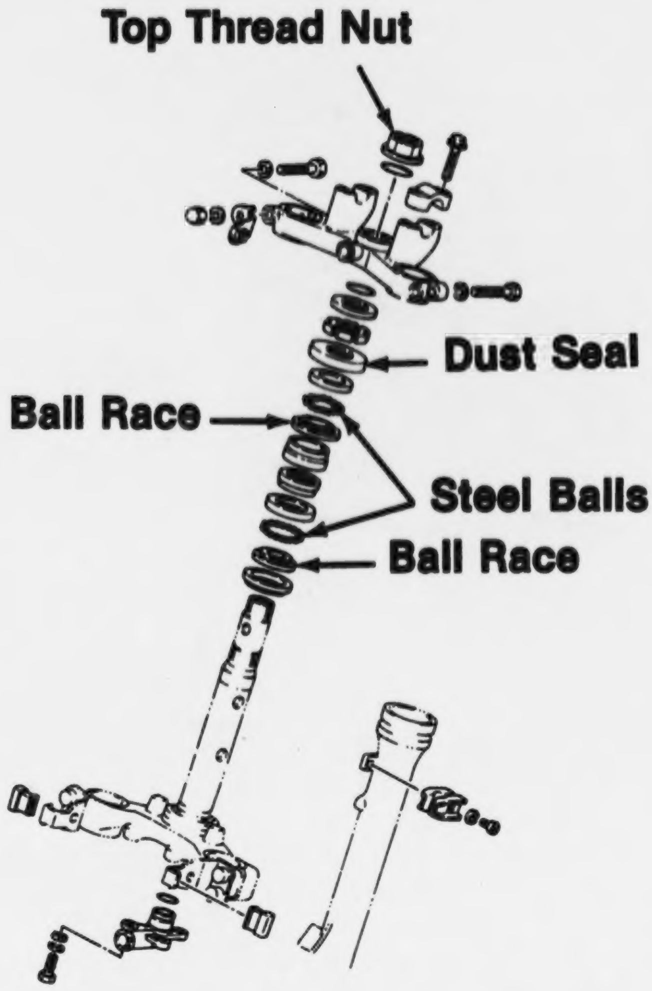
(NOTE: The special lubricant is usually an 80W or 90W gear oil, but in all cases, manufacturers' service specifications should be followed.)

Front Fork Components


Fork Spring
Air Valve
Fork Cap
Fork Piston
Fork Tube
Fork Slider
Dust Seal
Socket Bolt

Courtesy Yamaha Motor Corporation, U.S.A.

Steering Head Assembly


Top Thread Nut
Dust Seal
Ball Race
Steel Balls
Ball Race

Courtesy Yamaha Motor Corporation, U.S.A.

STEERING AND SUSPENSION SERVICE
UNIT XI

JOB SHEET #1 — CHANGE OIL IN A FRONT FORK

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Oil drain pan
6. Fork oil
7. Large box-end wrench or socket
8. Small funnel
9. Measuring container graduated in cc's
10. Solvent cleaning station
11. Compressed air supply
12. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Support the motorcycle so that the front wheel is off the ground.
3. Remove the front fork cap with the proper size box-end wrench or socket. (Figure 1)

   (NOTE: Keep a little pressure on the fork cap as you remove it so the preload on the front fork spring won't cause it to jump out at you.)

   FIGURE 1

JOB SHEET #1

4. Place the oil drain pan underneath one fork leg.

5. Remove the oil drain plug from the first fork leg, and drain the old oil out. (Figure 2)

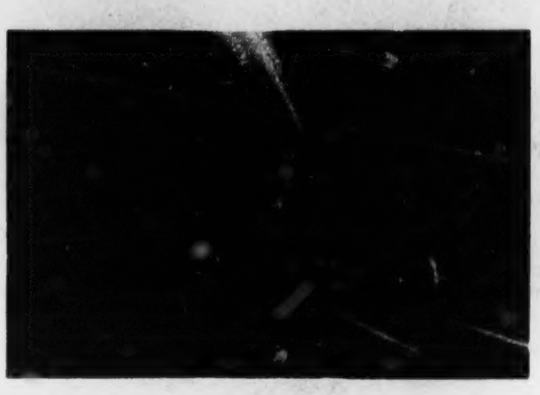
   (NOTE: If the old oil has a white or milky look, it means the front fork seals are leaking and should be replaced, and that procedure is outlined in Job Sheet #2.)

FIGURE 2

6. Allow the oil to completely drain.

7. Replace the oil drain plug and torque it to specifications. (Figure 3)

FIGURE 3



JOB SHEET #1

8. Clean the container you're going to measure oil in, and then fill it with fork oil in the amount specified in the service manual. (Figure 4)

FIGURE 4

9. Place a small funnel into the top of the front fork and pour the new fork oil in slowly. (Figure 5)

(NOTE: If you try to pour the oil too fast, the oil will overflow and it will be difficult to determine how much oil you've lost and you will have to drain the fork leg and start over.)

FIGURE 5

10. Place a shop towel underneath the funnel as you remove the funnel so you won't drip oil.

JOB SHEET #1

11. Inspect the O-ring or sealing washer on the fork cap, and replace as needed. (Figure 6)

FIGURE 6

12. Avoid cross-threading or damaging the fine threads on the fork cap as you replace it.

    (NOTE: The strength of the spring preload may make this part of the job a little testy, but take your time and start the threads by hand because using a wrench will almost always result in thread damage.)

13. Torque the fork cap to specifications.

14. Repeat the procedure for the other fork leg.

☐ Have your instructor check your work.

15. Clean up area and return tools and materials to proper storage.

STEERING AND SUSPENSION SERVICE
UNIT XI

JOB SHEET #2 — REPLACE FRONT FORK SEALS

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Oil drain pan
6. Fork oil
7. Large box-end wrench or socket
8. Small funnel
9. Measuring container graduated in cc's
10. Replacement fork seals
11. Snap-ring pliers
12. Fork seal driving tool
13. Lock-tite adhesive
14. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Support the motorcycle so that the front wheel is off the ground.
3. Remove the front fender and wheel assembly.
4. Remove the front brake caliper.
5. Remove the front fork cap with the proper size box-end wrench or socket.
6. Place the oil drain pan underneath one fork leg.

JOB SHEET #2

7. Remove the oil drain plug from the first fork leg, and drain the old oil out.
8. Replace the oil drain plug and torque it to specifications.
9. Loosen the pinch bolts that secure the first fork leg. (Figure 1)

FIGURE 1

10. Grasp the upper fork leg and twist it as you pull down to remove it from the upper and lower bridges. (Figure 2)

FIGURE 2

11. Wrap a shop towel around the lower fork section and lightly clamp the fork leg in a vise, but don't overtighten the vise.

JOB SHEET #2

12. Remove the allen-head bolt from the bottom of the fork leg. (Figure 3)

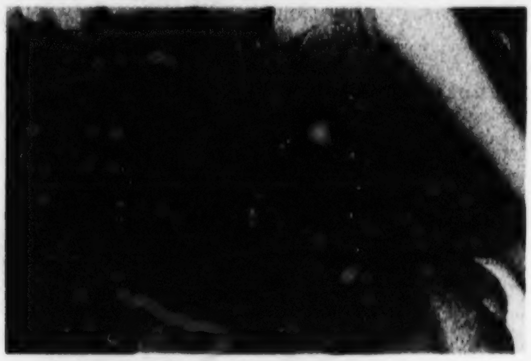
(NOTE: The allen-head bolt is probably sealed with Lock-Tite and getting it out will require using a pneumatic impact wrench with an allen socket; start and stop the impact wrench with an allen socket; start and stop the impact wrench at intervals as you pull out on the upper fork leg; you may repeat use of the impact wrench, but keep at it, and the allen head bolt will eventually unscrew.)

FIGURE 3

13. Remove the allen bolt but be sure to watch for and save the small copper sealing washer that seals the allen bolt. (Figure 4)

(NOTE: IF the washer does not come out, use a small screwdriver blade or a piece of wire with a hook on the end of it to work the washer free.)

FIGURE 4



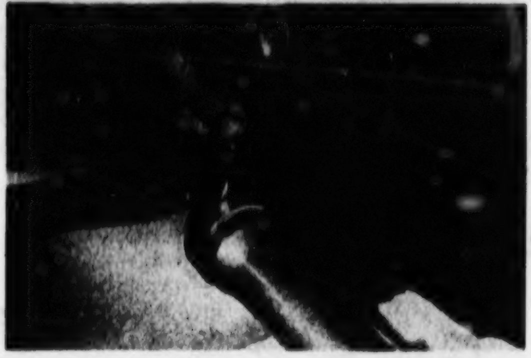
JOB SHEET #2

14. Remove the upper fork leg from the lower fork leg and set it aside. (Figure 5)

FIGURE 5

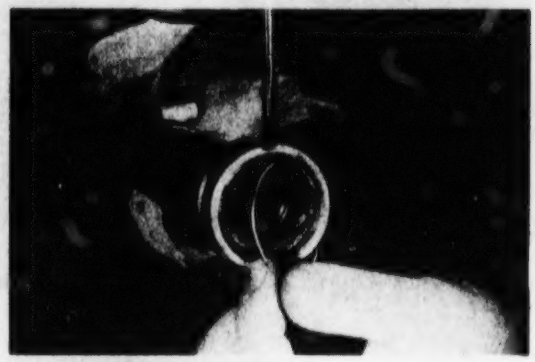
15. Remove the rubber dust cover from the top of the lower fork leg. (Figure 6)

FIGURE 6



16. Remove the snap ring that holds the fork seal in place. (Figure 7)

FIGURE 7

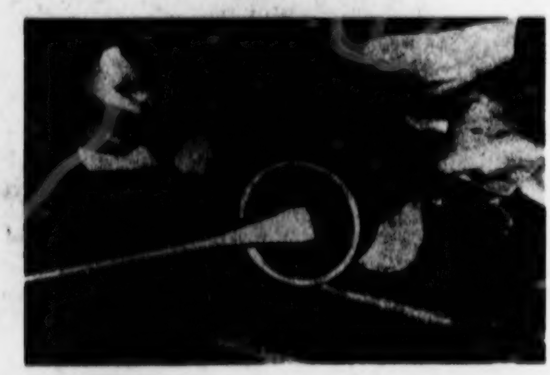


JOB SHEET #2

17. Remove the fork seal washer.

18. Use a fork seal puller or large screwdriver to remove the fork seal, and be careful that you don't gouge the fork seal housing. (Figure 8)

FIGURE 8

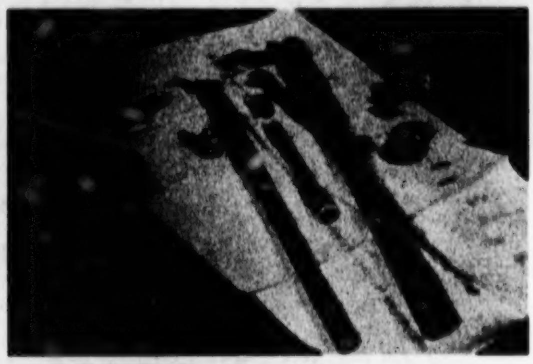


19. Remove the lower fork tube from the vise and lay it aside.

20. Disassemble the upper part of the fork tube that contains the piston. (Figure 9)

(NOTE: Pay attention to the position of the parts because they must be reassembled properly, and some tubes will have a spring at the bottom of the piston.)

FIGURE 9



21. Clean all parts thoroughly with solvent and dry with compressed air.

22. Reassemble the inner fork components and reinstall them into the lower fork leg.

(NOTE: You may want to put the assembly back into a smooth-jawed vise.)

JOB SHEET #2

23. Put a small amount of Lock-Tite on the thread of the lower fork leg allen-head bolt. (Figure 10)

FIGURE 10

24. Make sure the small copper sealing washer is on the allen head bolt, and then screw the allen-head bolt into the lower fork leg until it is tight.

25. Lubricate lightly the upper fork leg and work the new fork leg seal over the fork leg and into its seating position on the lower fork leg.

26. Put the fork seal driver onto the upper fork leg.

27. Work the fork seal driver by hand until the fork seal is seated firmly in position.

28. Remove the fork seal driver.

29. Install the fork seal washer.

30. Install the fork spring snap-ring, making sure that it seats properly in its groove.

JOB SHEET #2

31. Install the fork seal dust cover. (Figure 11)

FIGURE 11

☐ Have your instructor check your work.

32. Work the upper fork leg back into lower and upper bridges.

33. Position the top of the upper fork leg flush with the top of the upper bridge.

34. Tighten the pinch bolts to the torque specified in the service manual.

35. Clean the container you're going to measure oil in, and then fill it with fork oil in the amount specified in the service manual.

36. Place a small funnel into the top of the front fork and pour the new fork oil in slowly.

    (NOTE: If you try to pour the oil too fast, the oil will overflow and it will be difficult to determine how much oil you've lost and you will have to drain the fork leg and start over.)

37. Place a shop towel underneath the funnel as you remove the funnel so you won't drip oil all over the place.

38. Inspect the O-ring or sealing washer on the fork cap, and replace as needed.

39. Avoid cross-threading or damaging the fine threads on the fork cap as you replace it.

    (NOTE: The strength of the spring preload may make this part of the job a little testy, but take you time and start the threads by hand because using a wrench will almost always result in thread damage.)

JOB SHEET #2

40. Tighten the fork cap to specifications. (Figure 12)

FIGURE 12

☐ Have your instructor check your work.

41. Repeat all procedures for the other fork leg.

☐ Have your instructor check your work.

42. Install the front fender.

43. Install the front wheel.

44. Install the brake caliper.

☐ Have your instructor check your work.

45. Clean up area and return tools and equipment to proper storage.

STEERING AND SUSPENSION SERVICE
UNIT XI

JOB SHEET #3 — CHANGE FINAL DRIVE OIL

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Final drive oil
6. Oil drain pan
7. Small funnel
8. Measuring container graduated in cc's
9. Piece of cardboard or heavy construction paper
10. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Secure the bike in an upright position with the rear end off the floor.
3. Remove the final drive filler plug. (Figure 1)

FIGURE 1

JOB SHEET #3

4. Place the drain pan as close to the rear tire as possible.

5. Place a piece of cardboard or heavy paper in front of the rear tire so no oil will drain onto the rear tire. (Figure 2)

FIGURE 2

6. Remove the drain plug and let all the oil drain out. (Figure 3)

FIGURE 3

7. Inspect the drain plug magnet for metal particles.

   (NOTE: It is normal for fine metal particles that look like filings to be on the plug magnet, but there should be no large pieces of metal on the plug for that would indicate final drive damage.)

8. Wipe the metal particles off the drain plug magnet with a clean shop towel.

JOB SHEET #3

9. Inspect the sealing washer on the drain plug and replace it if it is damaged. (Figure 4)

FIGURE 4

10. Allow the oil to completely drain out and replace the oil drain plug.

11. Torque the oil drain plug to service manual specifications.

12. Wipe the measuring container with a clean shop towel and measure out the amount of final drive oil specified in the service manual.

13. Place a small funnel in the filler hole and pour the new final drive oil in slowly. (Figure 5)

FIGURE 5

JOB SHEET #3

14. Inspect the filler cap O-ring and replace it if it's damaged. (Figure 6)

FIGURE 6

15. Replace the filler cap and torque to specifications in the service manual.

16. Dispose of the old oil and the oily cardboard in a safe manner.

☐ Have your instructor check your work.

17. Clean up area and return tools and materials to proper storage.

STEERING AND SUSPENSION SERVICE
UNIT XI

JOB SHEET #4 — INSPECT AND REPLACE DRIVE CHAIN AND SPROCKETS

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Snap-ring pliers
6. Chain and sprocket replacements as required
7. Safety glasses

B. Routine #1 — Inspecting and removing an endless chain and sprockets

1. Put on safety glasses.
2. Secure the bike in an upright position with the rear wheel off the floor.
3. Inspect the chain and rear sprocket, and if both present evidence of wear, it is safe to assume that the front sprocket is also worn out, and the chain and both sprockets should be replaced.
4. Check for sprocket wear by looking for teeth that are bent or worn to a sharp point. (Figure 1)

FIGURE 1

JOB SHEET #4

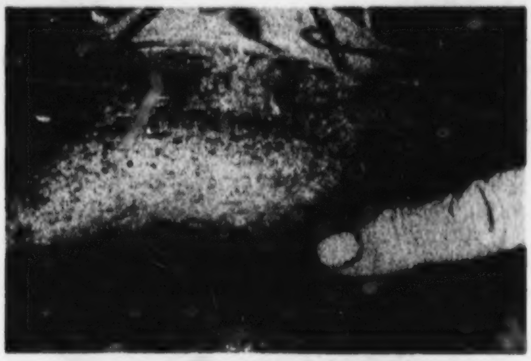
5. Look for missing or broken teeth on sprockets because this means they must be replaced.

6. Check for chain and sprocket wear by looking for a chain that doesn't fit into the teeth of the sprocket evenly, and if you can pull the chain out of the sprocket teeth, it's a sure sign the chain is worn out. (Figure 2)

FIGURE 2

7. Look for damaged or broken chain rollers because their presence also indicates a worn out chain. (Figure 3)

FIGURE 3



JOB SHEET #4

8. Slide the counter shaft sprocket off the counter shaft and remove the sprocket from the chain. (Figure 4)

FIGURE 4

9. Remove the chain from the motorcycle. (Figure 5)

FIGURE 5

10. Wash the swing arm, swing arm pivot pin, and pivot pin bushings with solvent and dry with compressed air.

11. Check the service manual for the pivot pin bushing wear limits.

12. Measure the ID of the pivot pin bushings with a telescoping gauge and a micrometer.

13. Compare your measurements with the specs from the service manual, and replace the bushings if they're beyond the wear limits.

    (NOTE: If you have to replace the bushings, drive the old ones out with a long punch or a bushing removing tool, and drive the new ones in with a soft-faced mallet.)

14. Lubricate the bushings and pivot pin with waterproof grease.

JOB SHEET #4

15. Install the new chain through the frame and place the new sprocket on the chain.

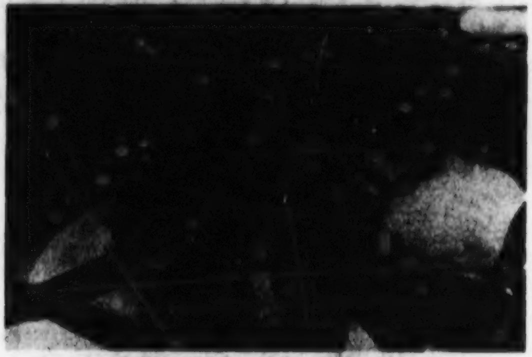
    (NOTE: Do not try to put the sprocket on first or you'll never get the chain onto it.)

16. Slide the new sprocket onto the countershaft and replace the bolt or clip that holds it on.

17. Remove the bolts or snap-ring that hold the rear sprocket to the rear wheel hub.

18. Remove the old sprocket from the hub. (Figure 6)

FIGURE 6



19. Install the new rear sprocket onto the rear wheel hub.

20. Replace the snap-ring or replace the bolts and torque them to specifications.

21. Place the rear wheel back on the motorcycle as outlined in Unit X.

22. Adjust the chain as outlined in the service manual.

    (NOTE: A new chain will loosen up during the first few miles of operation, and tightening the chain a slight amount more than specified will compensate for early chain stretching.)

23. Replace the mufflers.

☐ Have your instructor check your work.

24. Clean up area and return tools and equipment to proper storage.

STEERING AND SUSPENSION SERVICE
UNIT XI

JOB SHEET #5 — INSPECT AND ADJUST STEERING HEAD BEARINGS

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Waterproof grease
6. Special steering head nut wrench
7. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Secure the bike in an upright position with the front wheel off the ground.
3. Remove the front wheel assembly and front forks as outlined in Job Sheet #2 of this unit.
4. Remove the handlebars.
5. Remove the instrument cluster from the top fork bridge.
6. Remove the nut from the top fork bridge and remove the top fork bridge. (Figure 1)

FIGURE 1

JOB SHEET #5

7. Use the special steering head nut wrench to remove the lock nut and bearing adjustment nut. (Figure 2)

   (NOTE: As you remove the nut, hold the lower bridge up with your other hand so the lower bridge won't fall.)

FIGURE 2

8. Remove the cover or top bearing race housing from the steering stem. (Figure 3)

FIGURE 3

JOB SHEET #5

9. Remove the bearings with the following procedure:

   a. If the bearings are loose ball bearings, be very careful not to lose any of them, and if you let the lower bridge down too far, loose ball bearings will fall out of the steering stem. (Figure 4)

FIGURE 4

   b. If the bearings are tapered roller types, they are an assembly and there will be no loose bearings, but you must still hold the lower bridge up to keep the bearings from falling.

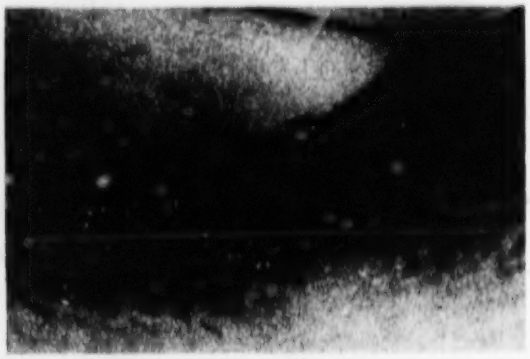
   c. If there are loose ball bearings, hold a shop towel under the lower bridge to catch the bearings as they fall, then remove the lower bridge.

   d. Tapered roller bearings will remain on the steering stem as you remove the lower bridge.

10. Wash the ball bearings in solvent and dry them with a clean shop towel.

11. Inspect all bearings, and if you find evidence of pits, roughness, or other damage, both the bearings and the races must be replaced. (Figure 5)

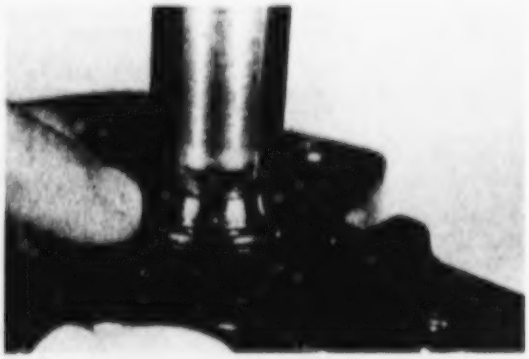
FIGURE 5



JOB SHEET #5

12. Wipe the bearing races clean with a shop towel, inspect them, and if there is evidence of roughness or cracks, both the races and the bearings must be replaced. (Figure 6)

FIGURE 6



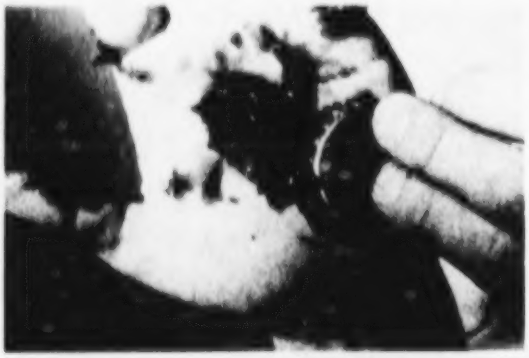
13. Grease a tapered roller bearing with the following procedure:

    a. Place a golf ball size gob of waterproof grease in the palm of one hand. (Figure 7)

    FIGURE 7

    b. Hold the bearing in your other hand and cut it into the corner of the grease to force the grease up through the rollers and bearing housing until clean grease comes through to the top side of the bearing. (Figure 8)

    FIGURE 8

JOB SHEET #5

c. Continue turning the timpken bearing a little at a time until the bearing is saturated with grease. (Figure 9)

FIGURE 9

d. Wipe off excess grease and place the bearing on a clean shop towel and repeat the procedure with the other bearing. (Figure 10)

FIGURE 10

14. Grease and install loose ball bearings with the following procedure:

    a. Grease all bearing races by applying a liberal amount of grease with your finger. (Figure 11)

FIGURE 11

JOB SHEET #5

b. Stick the clean loose ball bearings to the bearing race on the steering stem according to the number specified in the service manual. (Figure 12)

FIGURE 12

c. Push the steering stem into the steering head, taking care not to dislodge any of the loose ball bearings. (Figure 13)

FIGURE 13

d. Hold the lower bridge up in place and stick the specified number of bearings into the bearing race in the upper steering head.

e. Place the steering stem race and housing over the steering stem and slide it down in place, taking care not to dislodge the bearings already in place. (Figure 14)

FIGURE 14

JOB SHEET #5

f. Place the steering stem bearing adjusting nut onto the steering stem and tighten it lightly by hand.

15. Check the service manual for torque specifications and torquing procedure for the steering head bearing adjusting nut.

    (NOTE: Most specifications call for torquing the nut to a certain value, then loosening the nut, and then torquing it to another value; this serves to squeeze excess grease from the bearings and races and permits a proper adjustment.)

16. Use a clean shop towel to clean away any excess grease.
17. Install the top fork bridge, and put the nut on but do not tighten it up at this point.
18. Reinstall the front fork assembly into the upper and lower bridges.
19. Tighten the pinch bolts lightly to secure the front forks in place.
20. Reinstall the front wheel.
21. Tighten the top bridge nut to torque specifications in the service manual.
22. Loosen the pinch bolts and place the front forks flush with the top of the top bridge.
23. Tighten the pinch bolts to the torque specifications in the service manual.
24. Install the instrument cluster onto the top bridge.
25. Install the handlebars, and be sure to torque the bolts to specifications.
26. Turn the handlebars back and forth to make sure tha there is no binding or that cables are not obstructing free steering movement.

☐ Have your instructor check your work.

27. Clean up area and return tools and materials to proper storage.

STEERING AND SUSPENSION SERVICE
UNIT XI

PRACTICAL TEST #1
JOB SHEET #1 — CHANGE OIL IN A FRONT FORK

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed fork cap with proper tool.	2.	☐	☐
3. Drained fork oil into drain pan.	3.	☐	☐
4. Replaced oil drain plug and torqued properly.	4.	☐	☐
5. Used funnel to refill fork with proper oil.	5.	☐	☐
6. Checked sealing O-ring on fork cap.	6.	☐	☐
7. Replaced cap and torqued to specifications.	7.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

STEERING AND SUSPENSION SERVICE
UNIT XI

PRACTICAL TEST #2
JOB SHEET #2 — REPLACE FRONT FORK SEALS

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

> Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed front fork cap with proper tool.	2.	☐	☐
3. Drained fork oil and replaced plug.	3.	☐	☐
4. Removed first fork leg.	4.	☐	☐
5. Disassembled fork leg with proper procedure.	5.	☐	☐
6. Cleaned and inspected fork leg.	6.	☐	☐
7. Reassembled fork leg.	7.	☐	☐
8. Replaced fork leg on vehicle and filled with fork oil.	8.	☐	☐
9. Repeated procedure for other fork leg.	9.	☐	☐
10. Cleaned area and returned tools to storage.	10.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

STEERING AND SUSPENSION SERVICE
UNIT XI

PRACTICAL TEST #3
JOB SHEET #3 — CHANGE FINAL DRIVE OIL

Student's name ________________________ **Date** ____________

Evaluator's name ________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:			YES	NO
1.	Wore safety glasses.	1.	☐	☐
2.	Secured bike and removed filler plug.	2.	☐	☐
3.	Placed protection near rear wheel.	3.	☐	☐
4.	Removed drain plug and drained oil into pan.	4.	☐	☐
5.	Inspected drain plug for magnetic particles.	5.	☐	☐
6.	Wiped plug clean.	6.	☐	☐
7.	Inspected drain plug sealing washer.	7.	☐	☐
8.	Replaced drain plug and properly torqued.	8.	☐	☐
9.	Measured final drive oil according to specifications.	9.	☐	☐
10.	Poured oil in slowly.	10.	☐	☐
11.	Inspected, replaced, and torqued filler cap.	11.	☐	☐
12.	Disposed of old oil properly.	12.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #3 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

STEERING AND SUSPENSION SERVICE
UNIT XI

PRACTICAL TEST #4
JOB SHEET #4 — INSPECT AND REPLACE DRIVE CHAIN AND SPROCKETS

Student's name ______________________ **Date** ____________

Evaluator's name ______________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:

			YES	NO
1.	Wore safety glasses.	1.	☐	☐
2.	Secured bike.	2.	☐	☐
3.	Inspected chain and rear sprocket.	3.	☐	☐
4.	Inspected chain rollers.	4.	☐	☐
5.	Removed sprocket from chain.	5.	☐	☐
6.	Removed chain from motorcycle.	6.	☐	☐
7.	Washed swing arm, swing arm pivot pin, and pivot pin bushings with solvent and dried with compressed air.	7.	☐	☐
8.	Checked wear limits and measured ID of pivot pin bushings.	8.	☐	☐
9.	Lubricated bushings and pivot pin with waterproof grease.	9.	☐	☐
10.	Installed new chain.	10.	☐	☐
11.	Placed new sprocket onto countershaft.	11.	☐	☐
12.	Removed old sprocket from rear wheel hub.	12.	☐	☐
13.	Replaced rear wheel sprocket.	13.	☐	☐
14.	Adjusted chain to specifications.	14.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #4 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

STEERING AND SUSPENSION SERVICE
UNIT XI

PRACTICAL TEST #5
JOB SHEET #5 — INSPECT AND ADJUST STEERING HEAD BEARINGS

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed steering components in proper order.	2.	☐	☐
3. Removed bearings with proper procedure.	3.	☐	☐
4. Washed bearings in solvent and dried with shop towel.	4.	☐	☐
5. Inspected bearings and replaced worn bearings.	5.	☐	☐
6. Greased and replaced bearings.	6.	☐	☐
7. Replaced steering components.	7.	☐	☐
8. Checked steering for free movement.	8.	☐	☐
9. Cleaned area and returned tools to storage.	9.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #5 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

STEERING AND SUSPENSION SERVICE
UNIT XI

NAME ______________________

TEST

1. Match terms related to steering and suspension service with their correct definitions.

_____a. A way of controlling abrupt suspension movements with oil pressure directed through restricting oil passages

_____b. A tapered roller bearing

_____c. The part of a bearing that the rollers or balls fit into

_____d. The degree of pressure by which a spring is compressed or extended in a fixed state

_____e. The capacity of an oil to flow in relation to its thickness or thinness, usually expressed in terms of weight with higher numbers designating thicker oils

_____f. A chain without a master link

1. Viscosity
2. Spring preload
3. Dampening
4. Endless chain
5. Bearing race
6. Timpken bearing

2. Match terms related to front fork components with their functions.

_____a. The stationary part of the front fork assembly that fits into the upper and lower bridges of the steering assembly and contains small oil-restricting passages

_____b. Fits over the upper fork tube and is the part of the front fork assembly that the front wheel attaches to, and slides up and down on the upper fork tube to cushion impact

_____c. A tube that has a top sealing ring that attaches to the slider on the bottom end and fits inside the upper fork tube and controls oil movement in and out of oil passages in the upper fork tube

_____d. Provides the vertical tension needed to support the motorcycle

1. Fork seal
2. Dust seal
3. Bridges
4. Stem
5. Rebound spring
6. Main fork tube spring
7. Upper fork tube
8. Piston
9. Lower fork tube

TEST

_____e. Provides a cushion for the forks when they are suddenly extended to their fullest

_____f. A rubber cover that goes on top of the lower fork tube to protect the seal from dirt and water

_____g. A double or triple-lipped high pressure seal that seals the oil in the lower fork tube

_____h. Upper and lower triple clamps that attach to the motorcycle frame and both front forks

_____i. A common axle that hooks the lower and upper bridges together

3. Complete statements concerning front fork fluid by inserting the word(s) that best completes each statement.

   a. Front fork fluid is an oil that comes in different ____________ just like engine oil.

   b. ____________ ____________ is available in 5W, 10W, 15W, and 20W.

   c. Selection of the proper fork oil viscosity should always be according to specifications in the service manual because forks are designed for ____________ ____________ and ____________ ____________.

   d. Fork oil is the dampening fluid that ____________ up and down impact and rebound movement of the front forks and shocks.

   e. The heavier the oil, the more ____________ to free movement there will be.

   f. If front fork fluid has a white or milky color when it is drained, it indicates the presence of ____________ and means that the front fork seals are leaking and should be replaced.

4. Complete statements concerning steering head bearings by inserting the word(s) that best completes each statement.

   a. There are two kinds of steering head bearings:

      1) ____________ ____________ bearings

      2) ____________ ____________ bearings

   b. Loose ball bearings fit between an upper and as lower race and permit free turning between ____________ ____________ ____________ components.

TEST

c. ____________ ____________ ____________ fit into a tapered bearing race; steering free movement can be restricted according to the torque applied to the steering head adjustment nut.

d. When loose bearings are replaced, their ____________ should also be replaced.

5. Select true statements concerning swing arm pivot assemblies by placing an "X" beside each statement that is true.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Swing arm pivot assemblies anchor the swing arm so it cannot move up and down.

_____b. There are three basic types of pivot assemblies:

1) One type consists of bushings with a long pin or bolt that goes all the way through the assembly.

2) Another type of pivot has needle bearings in place of the bushings, and uses a long pin that goes all the way through to secure the assembly.

3) Another pivot type uses short bolts that are screwed into the frame from each side and have a pin on the end that fits into a loose ball bearing which is housed in the swing arm.

_____c. The bushing type pivots are used on small street and off-road bikes while the needle bearing type is used on racing bikes, and the tapered roller pivots are used on large street bikes.

6. Complete statements concerning sprockets and chain drives by inserting the word(s) that best completes each statement.

a. The final drive on some motorcycles consists of:

1) A counter shaft sprocket or ____________ ____________

2) A ____________ ____________ or driven sprocket

3) A ____________ ____________ which connects the two sprockets

b. A worn rear sprocket will almost always indicate that the other sprocket and chain are probably ____________ and should be replaced.

c. Both sprockets and the chain should be replaced at the same time because replacing only the chain or only a sprocket will result in ____________ ____________ to the single new component.

TEST

d. In a chain with a master link, the master link will be the ____________ link, and when this type of chain breaks, it is usually the ____________ link that breaks.

e. Master links can be replaced in chains that are still ____________.

f. Endless chains are more popular on larger displacement motorcycles because they are stronger and do not pose the problem of having a ____________ ____________ ____________.

g. The important part of assembling a master link is to make sure the open end of the ____________ goes in the ____________ direction of chain rotation.

7. Complete statements concerning belt drives by inserting the word(s) that best completes each statement.

   a. The final drive on some motorcycles consists of:

      1) A counter shaft pulley with ____________ ____________ cast into the pulley

      2) A driven pulley or rear pulley with ____________ ____________

      3) A drive belt which connects the ____________ ____________ which also has lugs on its inner face

   b. Worn belts can be replaced without having to replace ____________.

   c. A worn belt can always be identified by:

      1) ____________ or ____________ edges

      2) ____________ or ____________ lugs

      3) Obvious stretching indicated by a ____________ ____________ when the rear wheel has been fully adjusted to the rear

TEST

8. Complete statements concerning chain-drives by inserting the word(s) that best completes each statement.

    a. The final drive on some motorcycles consists of:

        1) A right-angle gear set to transfer ____________ from the engine to the drive shaft

        2) A drive shaft to transmit ____________ to the final drive

        3) A final drive consisting of a right-angle ____________ ____________ ____________ gear.

    b. Engine oil lubricates most front gear sets, but sometimes they're ____________ from the engine oil and the oil has to be changed in the gear housing as specified.

    c. The drive shaft has a universal joint, usually at the ____________ ____________, and very seldom requires service or replacement.

    d. The final drive gear set changes the rotation of the drive shaft ____________ and is splined to the rear wheel.

    e. The final drive gear set is usually lubricated with a special lubricant which must be ____________ periodically according to specifications.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

9. Demonstrate the ability to:

    a. Change oil in a front fork. (Job Sheet #1)

    b. Replace front fork seals. (Job Sheet #2)

    c. Change final drive oil. (Job Sheet #3)

    d. Inspect and replace drive chain and sprockets. (Job Sheet #4)

    e. Inspect and adjust steering head bearings. (Job Sheet #5)

STEERING AND SUSPENSION SERVICE
UNIT XI

ANSWERS TO TEST

1. a. 3
   b. 6
   c. 5
   d. 2
   e. 1
   f. 4

2. a. 7 f. 2
   b. 9 g. 1
   c. 8 h. 3
   d. 6 i. 4
   e. 5

3. a. Viscosities
   b. Fork oil
   c. Specific oils, specific use
   d. Restricts
   e. Resistance
   f. Water

4. a. 1) Loose ball
      2) Tapered rolling
   b. Two load bearing
   c. Tapered roller bearings
   d. Races

5. c

6. a. 1) Drive sprocket
      2) Rear sprocket
      3) Drive chain
   b. Worn
   c. Rapid wear
   d. Weakest, master
   e. Serviceable
   f. Weak master link
   g. Clip, opposite

7. a. 1) Driving lugs
      2) Driving lugs
      3) Two pulleys
   b. Pulleys
   c. 1) Frayed, damaged
      2) Cracked, missing
      3) Loose belt

ANSWERS TO TEST

8. a.
    1) Torque
    2) Torque
    3) Ring-and-pinion

   b. Isolated
   c. Engine end
   d. 90°
   e. Changed

9. Performance skills evaluated by practical tests

BRAKES
UNIT XII

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss types of brake systems, how to inspect for brake wear, and the importance of handling brake fluid carefully. The student should also be able to replace brake shoes and brake pads and bleed a hydraulic brake system. These competencies will be evidenced by correctly completing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to brakes with their correct definitions.
2. Differentiate between types of brake systems.
3. Complete statements concerning how a mechanical brake system works.
4. Complete statements concerning how a hydraulic brake system works.
5. Select true statements concerning brake drum wear.
6. Complete statements concerning brake fluid.
7. Select true statements concerning brake bleeding.
8. Demonstrate the ability to:
    a. Inspect brake shoes and brake pads for wear. (Job Sheet #1)
    b. Replace brake shoes on a drum-type brake and adjust the brake. (Job Sheet #2)
    c. Replace brake pads on a disc brake system. (Job Sheet #3)
    d. Bleed a hydraulic brake system. (Job Sheet #4)

BRAKES
UNIT XII

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Show samples of brake shoes and discuss brake shoe wear limits.

H. Show wear indicator locations and how to interpret wear indicators.

I. Demonstrate the procedure for bleeding hydraulic brakes.

J. Impress upon students the importance of handling brake fluid with care and how damaging brake fluid can be to a painted surface.

K. Show samples of brake fluid types and discuss the importance of compatibility.

L. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics.* New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

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C. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

D. *Honda Shop Manual '78-'81 CB/CM400's.* Gardena, CA: American Honda Motor Co., Ltd., 1980.

E. *Motorcycle Technician's Handbook.* Cypress, GA: Yamaha International Corporation, 1980.

BRAKES
UNIT XII

INFORMATION SHEET

I. **Terms and definitions**

A. Mechanical brakes — Brake systems that use cables or rods to transmit force from a lever or pedal to a brake assembly

B. Hydraulic brakes — Brake systems that use fluid to transmit force from a lever or pedal to a brake assembly

C. Brake caliper — The component in a disc-brake system that houses the brake pads and caliper piston

D. Brake rotor — A round, flat disc of steel or cast iron fixed with the wheel hub so that it rotates with the wheel as it provides flat surfaces for brake pads to contact

II. **Types of brake systems**

A. There are two types of brake systems:

1. Mechanical

2. Hydraulic

B. Mechanical brake systems transmit force through a cable or rod to a disc or drum brake system.

C. Hydraulic brake systems transmit pressure through a hose or line to a disc or drum brake system.

D. Drum-type brakes use shoes that move outward onto the brake drum surface to slow or stop wheel rotation.

E. Disc-type brakes have a steel disc between two brake pads which move inward onto the rotor to slow or stop wheel rotation.

III. **How a mechanical brake system works** (Transparency 1)

A. A mechanical brake system is operated by a hand lever or foot pedal.

B. Movement of the lever or pedal is transmitted by a cable or steel rod to the brake arm which is attached to the brake cam.

C. The brake cam rotates and spreads the brake shoes which move outward to contact the brake drum.

INFORMATION SHEET

   D. Friction created between the shoes and drum stops or slows rotation of the wheel.

IV. **How a hydraulic brake system works** (Transparency 2)

   A. A hydraulic brake system is operated by a hand lever or foot pedal.

   B. Movement of the lever or pedal causes a piston to move inside the master cylinder.

   C. Piston movement displaces fluid from the master cylinder through the lines to another piston in the brake caliper.

   D. Brake caliper piston movement forces brake pads to move inward and clamp surfaces of a disc.

   E. Friction created between the pads and the disc stops or slows rotation of the wheel.

V. **Brake drum wear**

   A. Brake drum wear is indicated by the presence of a lip on the outer edge of the brake drum.

   B. The lip or ridge is actually the original diameter of the brake drum, and the lip indicates that the area where the shoes contact the brake drum has worn away.

   C. Hairline heat cracks on the surface of a brake drum are caused by excessive heat and indicate a weakened brake hub that needs to be replaced.

   D. Glazing, the bluish, burned look on a brake drum, is the result of excessive heat; however, it has not weakened the drum and can be sanded off and the drum is still serviceable.

   E. Wear limits are determined by brake drum diameter and when in doubt about drum wear, always check the service manual.

VI. **Brake fluid**

   A. Before putting brake fluid into a system, always check the service manual for the type of fluid the system requires, and use only that fluid.

   B. Brake fluid will damage a painted surface almost instantly, and painted surfaces on a motorcycle should be protected with nonabsorbent coverings.

   C. Old brake fluids should never be reused and should be disposed of in an approved manner.

INFORMATION SHEET

D. Brake fluids are identified by DOT (Department of Transportation) numbers:

1. DOT 3 — Used mostly with drum brake systems
2. DOT 4 — Used mostly for disc brake systems, and most commonly used motorcycle brake fluid
3. DOT 5 — Used mostly with high performance and racing bike systems and for other applications

E. Brake fluids with different DOT numbers are incompatible and should NEVER be mixed.

VII. Brake bleeding

A. When air gets into a brake system, it has to be removed by bleeding the brakes.

B. Brake systems have bleeder valves to make brake bleeding possible.

C. Since brake fluid is damaging to painted surfaces, a drain tube should always be connected to the bleeder valve so that brake fluid can be directed into an oil drain pan.

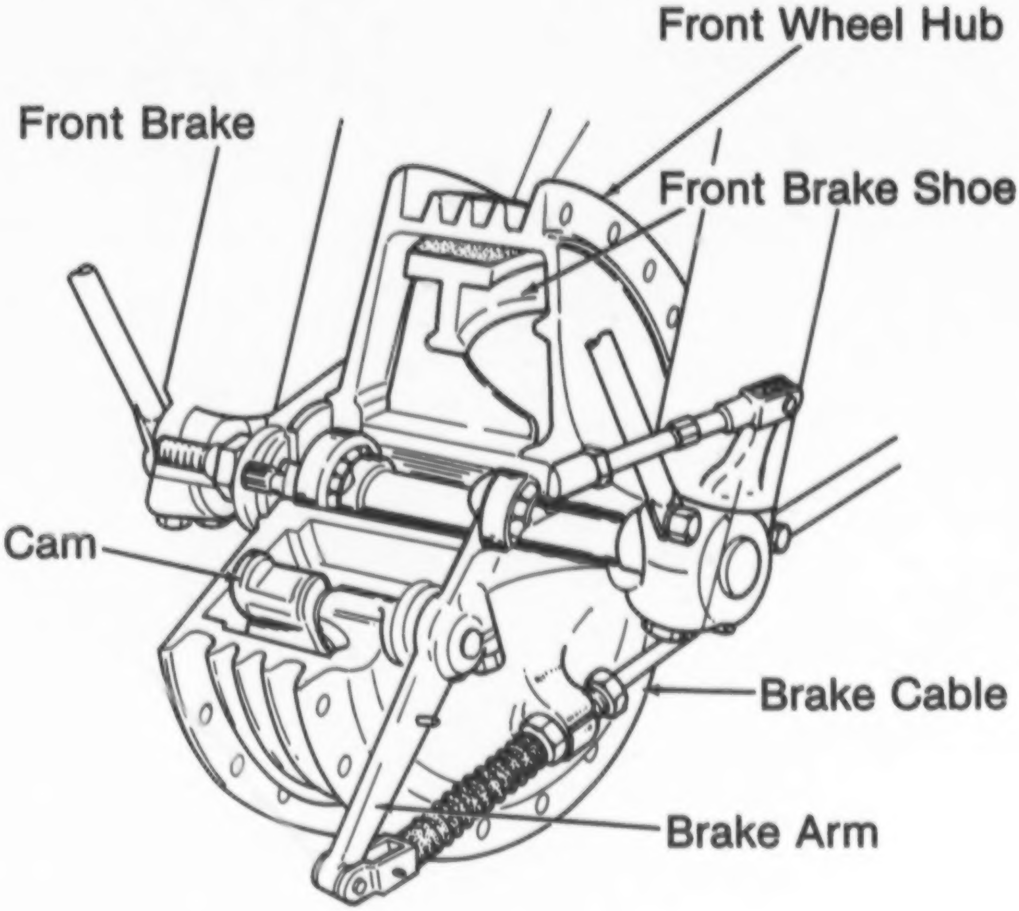
D. Using a clear plastic tube for bleeding is advantageous because it permits the technician to see the air bubbles as they come out with the brake fluid, and to see when the air bubbles quit coming out.

E. When bleeding brakes, NEVER permit the master cylinder fluid level to become low enough that air is pulled back into the system.

F. A spongy brake lever or pedal almost always indicates there is air in the brake system and that it should be bled.

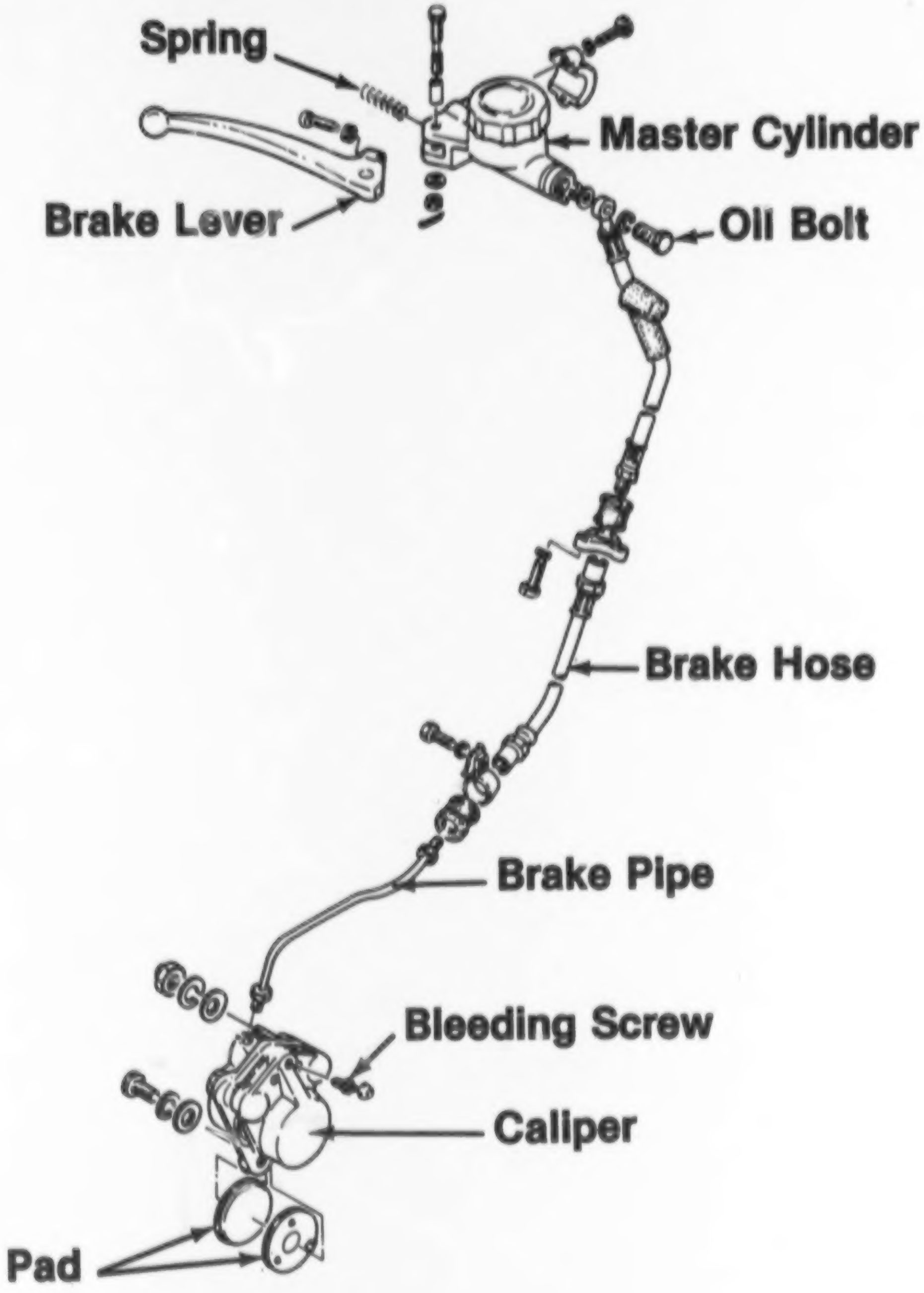
G. Make sure brake fluid is the type specified on the master cylinder cap or in the service manual.

Mechanical Brake System


Front Wheel Hub
Front Brake
Front Brake Shoe
Cam
Brake Cable
Brake Arm

Courtesy Yamaha Motor Corporation, U.S.A.

Hydraulic Brake System


Spring
Master Cylinder
Brake Lever
Oil Bolt
Brake Hose
Brake Pipe
Bleeding Screw
Caliper
Pad

Courtesy Yamaha Motor Corporation, U.S.A.

BRAKES
UNIT XII

JOB SHEET #1 — INSPECT BRAKE SHOES AND BRAKE PADS FOR WEAR

A. Tools and materials

1. Motorcycle as selected by instructor
2. Basic hand tools
3. Safety glasses

B. Routine #1 — Inspecting brake shoes

1. Put on safety glasses.
2. Secure the bike in an upright position.
3. Depress the brake lever or pedal, and if it does not return to its normal at rest position, that means:
   a. The brake may stick and needs to be cleaned and lubricated.

      (CAUTION: Do not get lubricant on brake pads or friction surfaces.)

   b. The brake shoes are worn to a point that the brake cam is going beyond center and sticking, and the shoes will have to be replaced.
4. Check for a brake shoe wear indicator on the side of the brake backing plate.
   a. If the wear pointer is at the wear limit index mark, the brake shoes must be replaced. (Figure 1)

FIGURE 1

JOB SHEET #1

   b. If the wear pointer has not reached the wear limit index mark, the brake shoes are okay, and if there is a sticking problem the brake system needs to be cleaned.

C. Routine #2 — Inspecting brake pads and hoses

1. Leave your safety glasses on.
2. Secure the bike in an upright position.
3. Inspect the brake pads for wear by removing the brake pad inspection cap.
4. Look at the brake pad lining for the presence of a wear-indicator groove that may also be painted red.
   a. If the groove is still present, it means the brake pads are still okay. (Figure 2)

FIGURE 2

   b. If the groove has worn away, it means the brake pads are worn and should be replaced.

   c. If the groove is within 1 mm to 2 mm of wearing out, the customer should be advised of the condition and new pads should be recommended.

5. Inspect brake hoses for weathering and cracking of the rubber covering, especially in areas where hoses bend or move back and forth during suspension travel.
6. Replace any hose that is beginning to crack.

☐ Have your instructor check your work.

7. Replace the brake pad inspection cap.
8. Clean up area and return tools and materials to proper storage.

BRAKES
UNIT XII

JOB SHEET #2 — REPLACE BRAKE SHOES ON A DRUM-TYPE BRAKE AND ADJUST THE BRAKE

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Vacuum cleaner
6. Replacement brake shoes
7. Emery cloth (120 grit)
8. Brake and contact cleaner
9. Safety glasses

B. Procedure

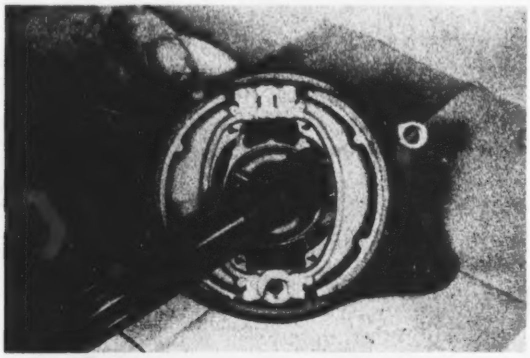
1. Put on safety glasses.
2. Secure the bike in an upright position with the front or rear off the ground depending on which brake you will be working on.
3. Remove the wheel assembly as previously outlined.
4. Remove the backing plate assembly from the brake drum.

JOB SHEET #2

5. Vacuum the dust and asbestos particles from the drum, brake shoes, and backing plate assembly. (Figure 1)

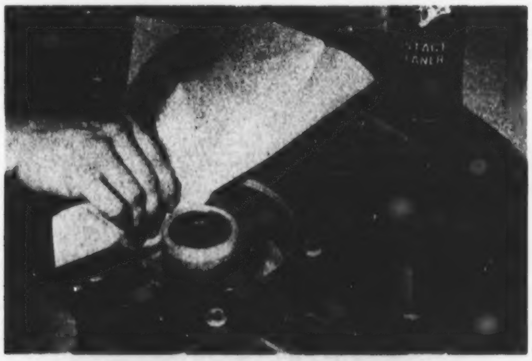
   (CAUTION: Do not blow brake contaminants out with compressed air because asbestos dust is a health hazard; check EPA standards.)

   FIGURE 1



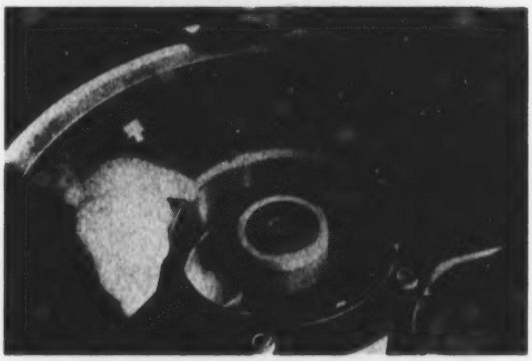
6. Dampen a shop towel with brake and contact cleaner and wipe the drum clean. (Figure 2)

   FIGURE 2



7. Inspect the brake drum for a ridge or lip near the outer edge, and if there is a ridge present it indicates excessive wear and the drum should be replaced. (Figure 3)

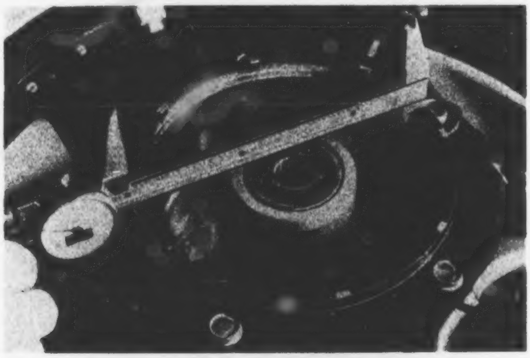
   FIGURE 3



JOB SHEET #2

8. Check the specifications for the diameter of the brake drum in the service manual, and measure the diameter of the brake drum if you are in doubt. (Figure 4)

FIGURE 4



9. Inspect the brake drum for hairline cracks which will indicate that the brake drum has been repeatedly overheated and should be replaced.

10. Inspect the brake drum for glazing and sand the glaze off with 120-grit emery cloth.

☐ Have your instructor check your work.

11. Remove the brake shoes from the backing plate by spreading the shoes with your hands. (Figure 5)

FIGURE 5

JOB SHEET #2

12. Check the specifications in the service manual for the length of the return springs.

13. Measure the return springs for length and compare your measurements with specifications and replace springs as required. (Figure 6)

FIGURE 6

14. Check the brake cam for free movement by turning the brake arm, and if the cam is difficult to turn, remove, clean, and lubricate it. (Figure 7)

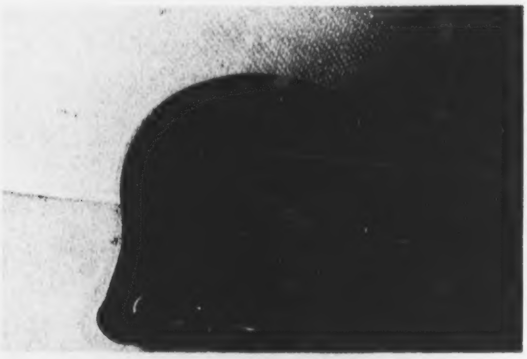
(NOTE: There are several procedures for removing brake cams, so check your service manual if you're in doubt.)

FIGURE 7

JOB SHEET #2

15. Apply a small amount of oil to the felt washer on the outside of the brake cam shaft where it goes through the backing plate. (Figure 8)

FIGURE 8



16. Apply a small amount of high temperature grease to the cam where it goes through the backing plate. (Figure 9)

FIGURE 9

17. Place the first brake shoe into position and hook the return springs to the brake shoe. (Figure 10)

JOB SHEET #2

18. Lay the other brake shoe on the backing plate so that both springs can be hooked up, and then pull the second brake shoe out and put it in position. (Figure 10)

    (NOTE: If you have trouble with this, you'll have to put both brake shoes into position and use vise grips to attach the springs.)

    FIGURE 10

19. Work the brake arm by hand to make sure the shoes spread and return properly. (Figure 11)

    FIGURE 11

20. Install the backing plate onto the brake drum.

21. Work the brake arm again to make sure the shoes spread and contact the inner surface of the brake drum.

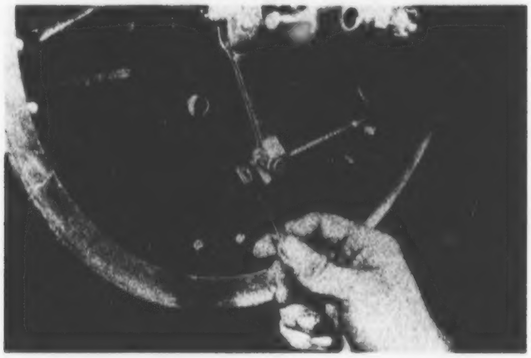
☐ Have your instructor check your work.

22. Install the wheel assembly back on the motorcycle as outlined in a previous job sheet.

JOB SHEET #2

23. Adjust the brake by tightening the adjustment nut on the brake cable or brake rod. (Figure 12)

FIGURE 12



24. Check the service manual to see how much free play there should be in brake lever or brake pedal, and tighten the adjustment nut accordingly.

25. Turn the wheel to make sure the new shoes aren't dragging.

(NOTE: A light amount of drag is acceptable, but a wheel that is difficult to turn will cause overheating and could pose an operator hazard.)

☐ Have your instructor check your work.

26. Test drive the bike only if your instructor says to do so.

27. Clean up area and return tools and materials to proper storage.

BRAKES
UNIT XII

JOB SHEET #3 — REPLACE BRAKE PADS ON A DISC BRAKE SYSTEM

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Small C-clamp
6. Emery cloth (120 grit)
7. Brake and contact cleaner
8. Replacement brake pads
9. Safety glasses

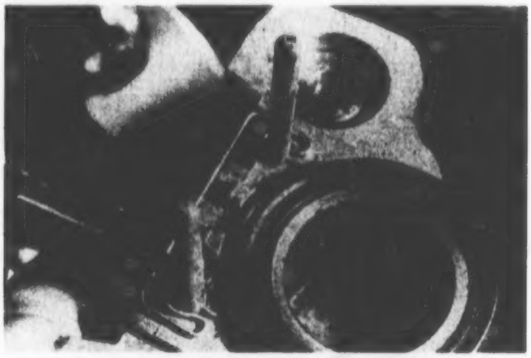
B. Procedure

1. Put on safety glasses.
2. Secure the bike in an upright position with the front or rear wheel off the ground depending on which brake you'll be working on.
3. Remove the brake caliper assembly from the motorcycle, if necessary.

JOB SHEET #3

4. Remove the anchor pin clips that secure the brake pads to the brake caliper, and remove the anchor pins. (Figure 1)

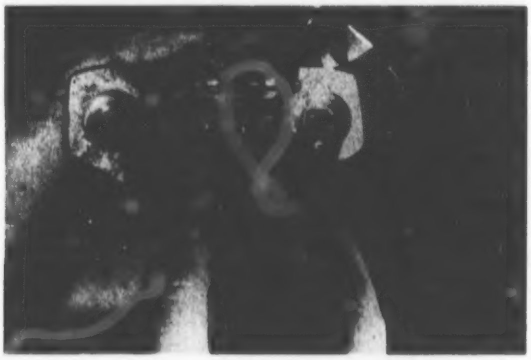
FIGURE 1



5. Remove the old brake pads, and note the position of thin stainless steel plate that insulates the brake pad from the caliper piston. (Figure 2)

(NOTE: The stainless steel plate must be reinstalled properly because it helps keep the brakes from squealing.)

FIGURE 2



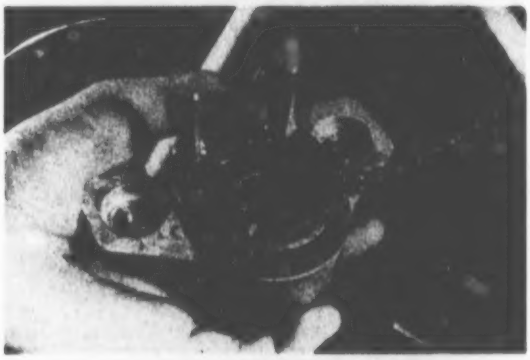
JOB SHEET #3

6. Compress the piston into the caliper bore with a small C-clamp, and check to make sure that it doesn't force brake fluid out of the master cylinder. (Figure 3)

FIGURE 3

7. Replace the stainless steel plate onto the brake pad next to the piston. (Figure 4)

FIGURE 4



8. Install the new brake pads onto the caliper. (Figure 5)

FIGURE 5

JOB SHEET #3

9. Install the anchor pins and replace the anchor pin clips.

   (NOTE: Make sure the anchor pin clips are installed properly because if the clips come off, the pins will come out and result in brake failure.)

☐ Have your instructor check your work.

10. Dampen a shop towel with brake and contact cleaner and wipe the brake rotor clean. (Figure 6)

FIGURE 6

11. Install the brake caliper.

12. Pump the brake lever or pedal or seat the new pads.

13. Turn the wheel to make sure it is moving freely, and remember that with disc brakes a slight drag is acceptable.

☐ Have your instructor check your work.

14. Clean up area and return tools and materials to proper storage.

BRAKES
UNIT XII

JOB SHEET #4 — BLEED A HYDRAULIC BRAKE SYSTEM

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Brake fluid
6. Clear plastic tubing (two feet)
7. Oil drain pan
8. Nonabsorbent fender cover
9. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Secure the bike in an upright position.
3. Put a nonabsorbent plastic cover over the gas tank or any other painted surfaces beneath the master cylinder.
4. Remove the cap from the master cylinder. (Figure 1)

FIGURE 1

JOB SHEET #4

5. Attach the brake bleeder clear plastic tubing on the brake bleeder valve and put the open end of the tubing in the oil drain pan.

   (CAUTION: Always use the bleeder tube to avoid any risk of getting brake fluid on the brake pads or any painted surface because brake fluid will damage a painted surface.)

6. Wipe the rubber diaphragm in the cap until it's clean, but do not wash the diaphragm or any other brake parts in solvent or any petroleum-base cleaners. (Figure 2)

FIGURE 2

7. Make sure the rubber diaphragm is in a depressed position when you replace the cap. (Figure 3)

FIGURE 3

JOB SHEET #4

8. Fill the master cylinder with new fluid, being very careful not to run it over. (Figure 4)

FIGURE 4

9. Replace the master cylinder cap, but do not tighten it. (Figure 5)

FIGURE 5

10. Open the brake bleeder valve about half a turn. (Figure 6)

FIGURE 6

JOB SHEET #4

11. Depress the brake lever or pedal and hold it.

12. Tighten the bleeder valve.

13. Let the brake lever or pedal return to its at rest position.

14. Repeat the bleeding procedure until there are no air bubbles in the fluid that is coming from the bleeder. (Figure 7)

    (NOTE: This is why a clear plastic tube is the best bleeding hose; you can see the air bubbles coming from the bleeder valve and you can also see when they stop.)

    FIGURE 7

15. Work the brake lever or pedal to see if it still has a soft, spongy feeling which would indicate there is still air in the brake system.

16. Repeat the bleeding procedure if there is evidence the system still has air in it.

☐ Have your instructor check your work.

17. Dispose of any old brake fluid in a safe manner as directed by your instructor.

    (NOTE: Old brake fluid should never be reused.)

18. Clean up area and return tools and materials to proper storage.

BRAKES
UNIT XII

PRACTICAL TEST #1
JOB SHEET #1 — INSPECT BRAKE SHOES AND BRAKE PADS FOR WEAR

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Checked brake shoe wear indicator.	2.	☐	☐
3. Removed brake pad inspection cap.	3.	☐	☐
4. Inspected pads for wear with wear-indicator groove.	4.	☐	☐
5. Inspected brake hoses for wear.	5.	☐	☐
6. Cleaned area and returned tools to storage.	6.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BRAKES
UNIT XII

PRACTICAL TEST #2
JOB SHEET #2 — REPLACE BRAKE SHOES ON A DRUM-TYPE BRAKE AND ADJUST THE BRAKE

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

> Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed components and vacuumed brake.	2.	☐	☐
3. Cleaned and inspected brake drum.	3.	☐	☐
4. Removed brake shoes and inspected brake cam.	4.	☐	☐
5. Replaced shoes with proper procedure.	5.	☐	☐
6. Installed and adjusted brake.	6.	☐	☐
7. Verified that new shoes weren't dragging.	7.	☐	☐
8. Cleaned area and returned tools to storage.	8.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BRAKES
UNIT XII

PRACTICAL TEST #3
JOB SHEET #3 — REPLACE BRAKE PADS ON A DISC BRAKE SYSTEM

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed brake caliper and old brake pads.	2.	☐	☐
3. Checked caliper bore piston and master cylinder.	3.	☐	☐
4. Installed new brake pads with correct procedure.	4.	☐	☐
5. Installed brake caliper and checked brake.	5.	☐	☐
6. Cleaned area and returned tools to storage.	6.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #3 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BRAKES
UNIT XII

PRACTICAL TEST #4
JOB SHEET #4 — BLEED A HYDRAULIC BRAKE SYSTEM

Student's name ____________________ **Date** __________

Evaluator's name ____________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Checked master cylinder.	2.	☐	☐
3. Attached proper bleeder hose.	3.	☐	☐
4. Filled master cylinder with care.	4.	☐	☐
5. Opened bleeder valve properly and bled brake.	5.	☐	☐
6. Purged line of all air.	6.	☐	☐
7. Disposed of old brake fluid safely.	7.	☐	☐
8. Cleaned area and returned tools to storage.	8.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #4 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BRAKES
UNIT XII

NAME ______________________

TEST

1. Match terms related to brakes with their correct definitions.

______a.	Brake systems that use cables or rods to transmit force from a lever or pedal to a brake assembly	1. Brake caliper 2. Brake rotor
______b.	Brake systems that use fluid to transmit force from a lever or pedal to a brake assembly	3. Mechanical brakes 4. Hydraulic brakes
______c.	The component in a disc-brake system that houses the brake pads and caliper piston	
______d.	A round, flat disc of steel or cast iron fixed with the wheel hub so that it rotates with the wheel as it provides flat surfaces for brake pads to contact	

2. Differentiate between types of brake systems by placing an "X" beside the definition of a mechanical brake system.

______a. Brake systems which transmit force through a cable or rod to a disc or drum brake system

______b. Brake systems which transmit pressure through a hose or line to a disc or drum brake system

3. Complete statements concerning how a mechanical brake system works by inserting the word(s) that best completes each statement.

a. A mechanical brake system is operated by a ____________ ____________ or ____________ ____________.

b. Movement of the lever or pedal is transmitted by a cable or steel rod to the brake arm which is attached to the ____________ ____________.

c. The brake cam ____________ and ____________ the brake shoes which move outward to contact the brake drum.

d. Friction created between the ____________ and ____________ stops or slows rotation of the wheel.

TEST

4. Complete statements concerning how a hydraulic brake system works by inserting the word(s) that best completes each statement.

   a. A hydraulic brake system is operated by a ____________ ____________ or ____________ ____________.

   b. Movement of the lever or pedal causes a ____________ to move inside the master cylinder.

   c. ____________ movement displaces fluid from the master cylinder through the lines to another ____________ in the brake caliper.

   d. Brake caliper piston movement forces brake pads to ____________ ____________ and ____________ ____________ of a disc.

   e. ____________ created between the pads and the disc stops or slows rotation of the wheel.

5. Select true statements concerning brake drum wear by placing an "X" beside each statement that is true.

   _____a. Brake drum wear is indicated by the presence of a lip on the outer edge of the brake drum.

   _____b. The lip or ridge is actually the original circumference of the brake drum, and the lip indicates that the area where the shoes contact the brake drum has worn away.

   _____c. Hairline heat cracks on the surface of a brake drum are caused by excessive heat and indicate a weakened brake hub that needs to be replaced.

   _____d. Glazing, the bluish, burned look on a brake drum, is the result of excessive heat; however, it has not weakened the drum and can be sanded off and the drum is still serviceable.

   _____e. Wear limits are determined by brake drum diameter, and when in doubt about drum wear, use common sense.

6. Complete statements concerning brake fluid by inserting the word(s) that best completes each statement.

   a. Before putting brake fluid into a system, always check the ____________ ____________ for the type of fluid the system requires, and use only that fluid.

   b. Brake fluid will damage a painted surface almost instantly, and painted surfaces on a motorcycle should be protected with ____________ coverings.

   c. Old brake fluids should never be ____________ and should be ____________ of in an approved manner.

TEST

d. Brake fluids are ____________ by DOT numbers:

1) DOT 3 — Used mostly with ____________ ____________ systems

2) DOT 4 — Used mostly for ____________ ____________ systems, and most commonly used motorcycle brake fluid

3) DOT 5 — Used mostly with ____________ ____________ and ____________ ____________ systems and for other applications

e. Brake fluids with different DOT numbers are ____________ and should NEVER be mixed.

7. Select true statements concerning brake bleeding by placing an "X" beside each statement that is true.

_____a. When air gets into a brake system, it has to be removed by bleeding the brakes.

_____b. Brake systems have bleeder valves to make brake bleeding possible.

_____c. Since brake fluid is damaging to painted surfaces, a drain tube should always be connected to the bleeder valve so that brake fluid can be directed into an oil pan.

_____d. Using a dark plastic tube for bleeding is advantageous because it permits the technician to see the air bubbles as they come out with the brake fluid, and to see when the air bubbles quit coming out.

_____e. When bleeding brakes, ALWAYS permit the master cylinder fluid level to become low enough that air is pulled back into the system.

_____f. A spongy brake lever or pedal almost always indicates there is air in the brake system and that it should be bled.

_____g. Make sure brake fluid is the type specified on the master cylinder cap or in the service manual.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

8. Demonstrate the ability to:

a. Inspect brake shoes and brake pads for wear. (Job Sheet #1)

b. Replace brake shoes on a drum-type brake and adjust the brake. (Job Sheet #2)

c. Replace brake pads on a disc brake system. (Job Sheet #3)

d. Bleed a hydraulic brake system. (Job Sheet #4)

BRAKES
UNIT XII

ANSWERS TO TEST

1. a. 3
   b. 4
   c. 1
   d. 2

2. a

3. a. Hand lever, foot pedal
   b. Brake cam
   c. Rotates, spreads
   d. Shoes, drum

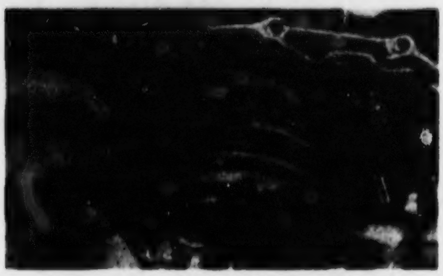
4. a. Hand lever, foot pedal
   b. Piston
   c. Piston, piston
   d. Move inward, clamp surfaces
   e. Friction

5. a, c, d

6. a. Service manual
   b. Nonabsorbent
   c. Reused, disposed
   d. Identified
      1) Drum brake
      2) Disc brake
      3) High performance, racing bike
   e. Incompatible

7. a, b, c, f, g

8. Performance skills evaluated by practical tests.



CLUTCHES
UNIT XIII

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify parts of a motorcycle clutch and discuss guidelines for clutch service. The student should also be able to remove, disassemble, inspect, and reassemble a motorcycle clutch. These competencies will be evidenced by correctly completing the procedures outlined in the job sheet and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to clutches with their correct definitions.
2. Match major clutch parts with their functions.
3. Complete statements concerning clutch operations.
4. Select true statements concerning clutch discs and plates.
5. Complete statements concerning other clutch parts.
6. Select true statements concerning guidelines for clutch service.
7. Demonstrate the ability to remove, disassemble, inspect, and reassemble a motorcycle clutch. (Job Sheet #1)

CLUTCHES
UNIT XIII

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparency.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheet.

G. Impress upon students the importance of not trying to pry the tab into position on the clutch nut.

H. Show push rod and contact type actuators and discuss their operations and service requirements.

I. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics.* New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

B. Johns, Bruce A., and David D. Edmundson. *Motorcycles Fundamentals, Service, Repair.* South Holland, IL: The Goodheart-Willcox Co., Inc., 1984.

C. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

D. *Honda Shop Manual '78-'81 CB/CM400's.* Gardena, CA: American Honda Motor Co., Ltd., 1980.

E. *Motorcycle Technician's Handbook.* Cypress, GA: Yamaha International Corporation, 1980.

CLUTCHES
UNIT XIII

INFORMATION SHEET

I. **Terms and definitions**

A. Clutch mud — The residue from clutch disc wear that accumulates in the bottom of a clutch case

B. Free length — The measured length of a clutch spring under no pressure

C. Splines — A mating set of inner and outer teeth that fit together to transmit torque from one part to another

D. Pivot bolt — The contact lever bolt that attaches the lever to its mount

E. Spring washer — A saucer-shaped washer that insures even distribution of pressure onto the clutch when the clutch nut is torqued down.

F. Wet clutch — A clutch that is immersed in oil to provide cooling and lubrication for moving parts

II. **Major clutch parts and their functions** (Transparency 1)

A. Clutch outer housing — A slotted housing that is splined to the clutch discs to transmit torque from the engine to the clutch discs

B. Pressure plate — The moveable part of the clutch that permits the clutch to be engaged or released

C. Clutch discs — Lightweight aluminum plates coated with a material that causes friction

D. Clutch plates — Steel discs positioned between the clutch discs to transmit torque from the clutch outer to the clutch center

E. Clutch center hub — A hub splined to the clutch plates and to the clutch shaft to transmit torque from the clutch plates to the clutch shaft

F. Clutch springs — Stiff, short springs that provide the pressure needed to squeeze the clutch discs and plates together

III. **Clutch operations**

A. A motorcycle clutch usually operates with a lever attached to a cable which is attached to another lever attached to the clutch release mechanism.

B. When the clutch lever is depressed on the handlebars, mechanical force is transmitted through the release mechanism where it pushes or pulls the clutch lifter plate that depresses the clutch springs and allows the clutch plates and clutch discs to separate and turn one within the other.

INFORMATION SHEET

C. An activated clutch permits engine torque to be disconnected from the power train to the final drive.

D. When the clutch lever is released, the clutch springs move the pressure plate into the clutch discs and plates, squeeze them together to cause friction between the clutch center and clutch outer to transmit power from the engine to the final drive.

IV. Clutch discs and plates

A. Clutch plates sometimes have minor differences and must be assembled in proper order to insure proper clutch operations.

B. Clutch discs sometimes have minor differences too and must also be assembled in proper order to insure proper clutch operations.

C. Clutch plates may vary in thickness, have oil holes drilled in them, or be slightly saucer shaped.

D. Clutch discs may have alternating directional grooves to force oil out or to pull oil in.

E. Clutch discs may be of the same thickness but vary in width or may vary in both thickness and width.

F. It is essential to install clutch plates and clutch discs in their proper order and facing the right direction.

V. Other clutch parts

A. Clutch release bearings are placed on clutches to allow the clutch to spin and the clutch release mechanism to remain stationary and functions only when the clutch is released.

B. Bushings, collars, and washers are used to space clutch components apart so that components can turn freely.

C. Clutch spring bolts that go through the lifter plate should always be removed by turning the single bolts no more than two turns at a time, and in a sequence that will allow spring pressure to be released evenly on the pressure plate lift bosses.

D. Clutch spring bolts that go through the lifter plate should always be installed by turning the single bolts no more than two turns at a time, and in a sequence that will allow spring pressure to be developed evenly on the pressure plate lift bosses.

E. During removal, gaskets or O-rings on clutch covers seldom break, but if they do, mating surfaces should be cleaned and a new gasket or O-ring installed.

INFORMATION SHEET

VI. Guidelines for clutch service

A. Clutch plates are made of steel and seldom wear out, but they often warp because of excess heat and should always be checked for flatness when servicing a clutch.

B. When a clutch will not disengage completely, it's a good indication that the clutch plates are warped, causing difficult shifting and a tendency for the motorcycle to creep forward even when the clutch is disengaged.

C. When a clutch slips during acceleration, it is an indication of worn clutch discs, weak springs, or improper clearance on the adjustor screw.

D. When a clutch slips or won't release, always check the clutch adjustment first.

E. Wear limits on a single clutch disc is less than .05 mm and although that seems slight, when wear is multiplied by the total number of discs in a clutch, the wear becomes significant.

F. Spring free length should always be checked, and if only one of the spring free lengths is short of specified limits, all springs should be replaced to assure even pressure.

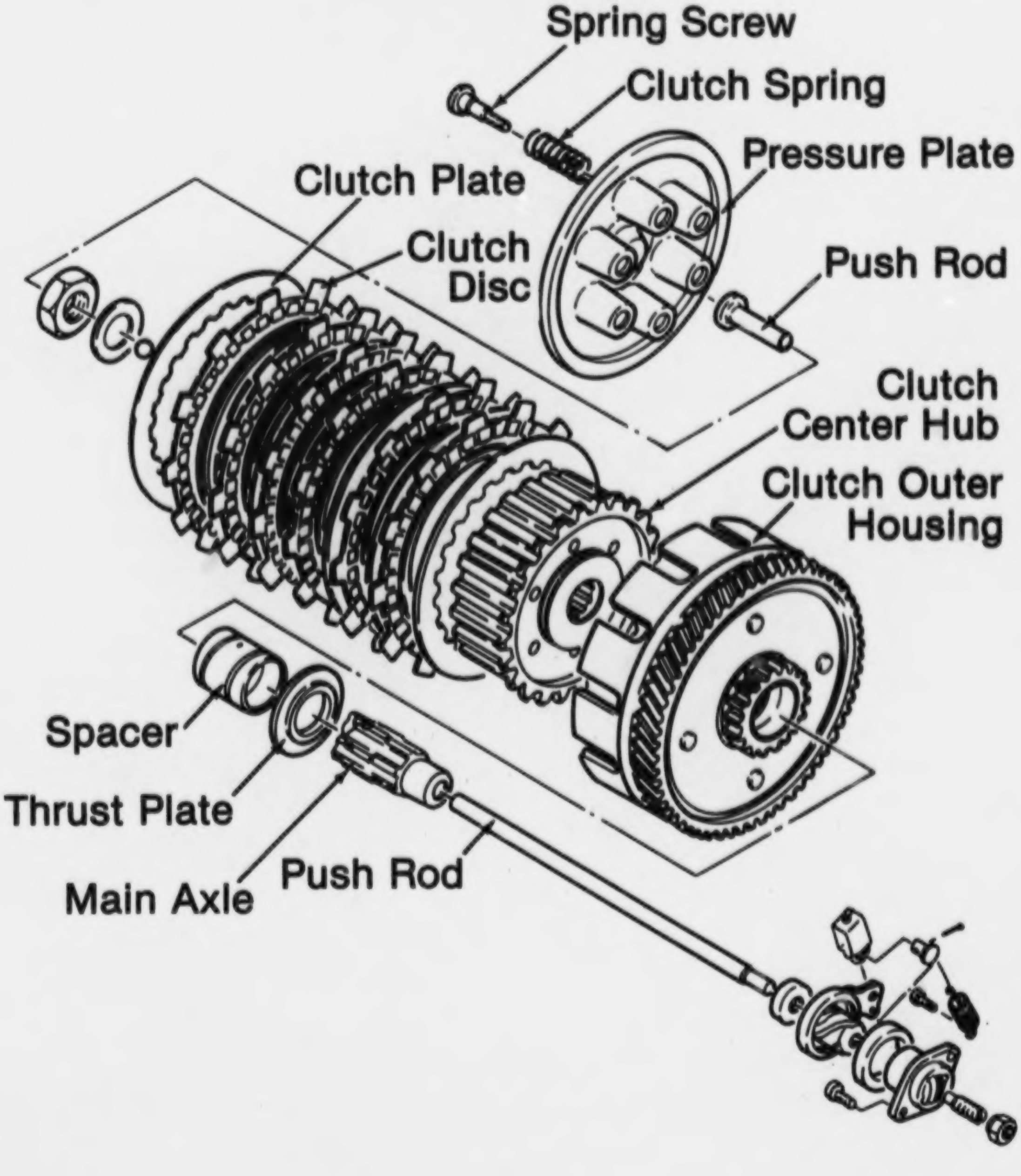
G. Even though only one clutch spring free length may be short, all springs in the clutch should be replaced to assure even pressure at all points of the pressure plate.

H. New clutch discs should be thoroughly lubricated in engine oil before assembly.

I. Clutch separators are sometimes rubber O-rings or wavy steel bands that fit between the clutch plates to insure complete disengagement of the clutch.

J. When a clutch lever will not release freely, check for a dirty or rusted clutch lever.

Parts of a Clutch


Spring Screw
Clutch Spring
Pressure Plate
Clutch Plate
Clutch Disc
Push Rod
Clutch Center Hub
Clutch Outer Housing
Spacer
Thrust Plate
Main Axle
Push Rod

Courtesy Yamaha Motor Corporation, U.S.A.

CLUTCHES
UNIT XIII

JOB SHEET #1 — REMOVE, DISASSEMBLE, INSPECT, AND REASSEMBLE A MOTORCYCLE CLUTCH

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Clutch-nut removing tool
6. Impact gun
7. Vernier or dial caliper
8. Oil drain pan
9. Safety glasses

B. Routine #1 — Removing the clutch

1. Put on safety glasses.
2. Secure the bike in an upright position.
3. Drain the engine oil.
4. Remove the tachometer cable, if required. (Figure 1)

FIGURE 1

JOB SHEET #1

5. Remove the clutch cable. (Figure 2)

FIGURE 2

6. Remove the foot peg and exhaust pipe, if required. (Figure 3)

FIGURE 3

7. Remove the kick starter arm and gear shift lever, if required. (Figure 4)

FIGURE 4

JOB SHEET #1

8. Remove the clutch cover. (Figure 5)

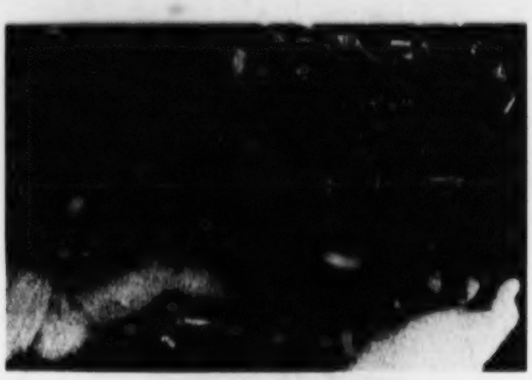
(NOTE: Pay close attention to where all bolts come from so you can get them back in their right places, and also pay attention to cable and wiring clamps so they can be properly replaced.)

FIGURE 5

9. Remove the bolts from the clutch lifter plate by loosening bolts no more than two turns at a time so spring pressure will not break the lifter plate on the clutch center hub. (Figure 6)

(CAUTION: The clutch springs exert so much pressure the plate will break if bolts are completely removed one at a time because that would leave all the pressure on the last bolt and cause the plate to snap in two.)

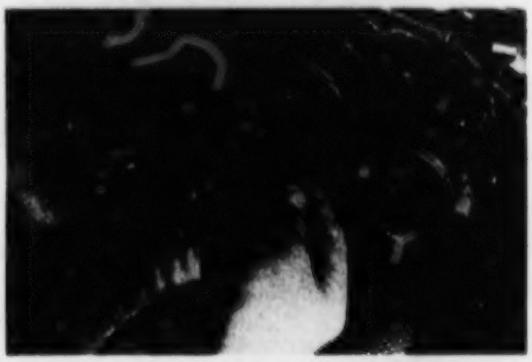
FIGURE 6



JOB SHEET #1

10. Remove the lifter plate and springs and place them aside for inspection. (Figure 7)

FIGURE 7



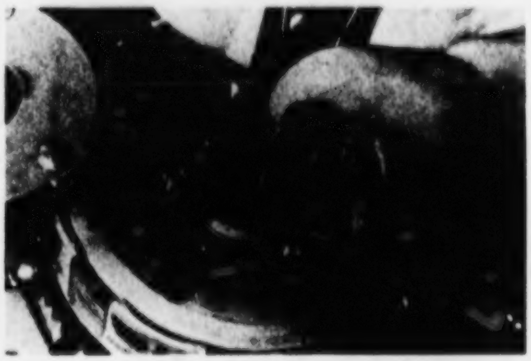
11. Check the clutch nut for a locking tab, and if there is one, pry the tab out of the way with a small chisel.

(NOTE: The clutch nut may be secured by a saucer-shaped spring washer or there may be a spring washer behind the nut, and this will come off after the clutch nut is removed.)

12. Remove the clutch nut with a clutch-nut removing tool and an impact gun, or remove the snap-ring with snap-ring pliers. (Figure 8)

(NOTE: Sometimes clutch nuts have a left-hand thread and will be clearly marked, so check for an arrow that would so indicate and set the impact gun as required.)

FIGURE 8



JOB SHEET #1

13. Remove the oil filter rotor so you can get to the clutch assembly. (Figure 9)

FIGURE 9

14. Reach in and pull the clutch out as an assembly and place it aside. (Figure 10)

FIGURE 10

15. Look on the shaft that you pulled the clutch off of for washers, bushings, or bearings, and note carefully their order as you remove them because they will have to be placed in order in the clutch when you reinstall the clutch.

☐ Have your instructor check your work.

C. Routine #2 — Disassembling and inspecting the clutch

1. Leave your safety glasses on.

2. Inspect the clutch cover for clutch mud that would indicate clutch material has been burned away.

   (NOTE: The presence of clutch mud is always accompanied by a strong smell of burnt friction material, and sometimes the smell is so strong you can even detect it in the oil.)

3. Check with your instructor if you suspect severe clutch wear.

JOB SHEET #1

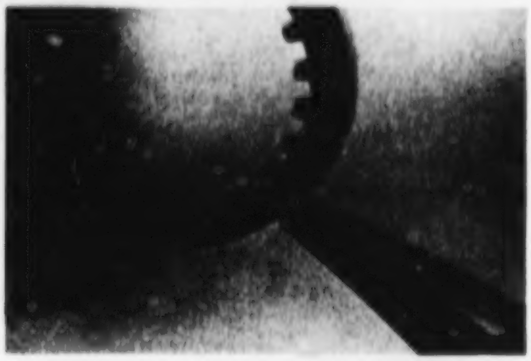
4. Note the position of washers, plates, spacers, bushings, and clutch-plate separators as you disassemble the clutch because it is important that these items be replaced in order.

5. Clean the clutch parts in cleaning solvent and wipe them dry with a clean shop towel. (Figure 11)

FIGURE 11

6. Inspect the solid steel clutch plates for discoloration, hairline heat cracks, and for warpage by placing them on a flat surface and working a feeler gauge under them in several locations. (Figure 12)

FIGURE 12



7. Check the service manual for clutch plate warpage limits and compare with inspection, and enter the information on the clutch service log that accompanies this job sheet.

JOB SHEET #1

8. Measure each clutch disc with a caliper in at least four places and compare your measurements with the wear limits in the service manual; record on your service log. (Figure 13)

FIGURE 13

9. Check the clutch outer drum for damage or wear that will appear as nicks or indentations caused by the clutch discs. (Figure 14)

FIGURE 14

10. Inspect the pressure plate for wear that will appear where the face of the plate contacts the clutch disc. (Figure 15)

FIGURE 15

JOB SHEET #1

11. Inspect the bosses on the pressure plate for cracks or damaged threads where the clutch spring bolts fit.

12. Inspect the clutch center for damage or wear that will appear as nicks or indentations caused by the clutch plates. (Figure 16)

FIGURE 16

13. Inspect disc spring and set ring assembly for the proper clearance between the two parts as outlined in the service manual.

14. Check the clutch plate separators for damage or wear.

15. Check the service manual for the proper clutch spring free length, then measure all the springs and compare your measurements with the limits in the service manual; record on your service log. (Figure 17)

(NOTE: If only one spring does not meet service specifications, all springs should be replaced to insure uniform pressure and proper clutch release.)

FIGURE 17

JOB SHEET #1

16. Inspect the gear teeth on the clutch outer for wear that will appear as chipped or broken teeth.

    (NOTE: If you find broken or chipped teeth here, the gear that drives the clutch outer will probably have to be replaced too.)

17. Check behind the clutch to see if a kick starter gear is incorporated with the assembly, and inspect it for chipped or damaged teeth.

☐ Have your instructor check your work.

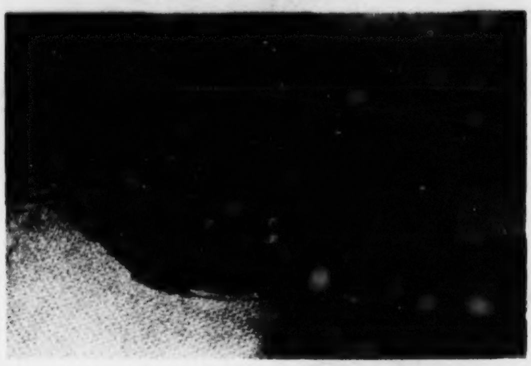
D. Routine #3 — Reassembling the clutch

1. Leave your safety glasses on.

2. Place the clutch outer down flat on a workbench and place the pressure plate, clutch discs, and clutch plates into the outer in their proper order. (Figure 18)

   (NOTE: If the pressure plate has washers or collars between it and the clutch outer, make sure they're in place, and the rest of the clutch will have to be assembled on the shaft.)

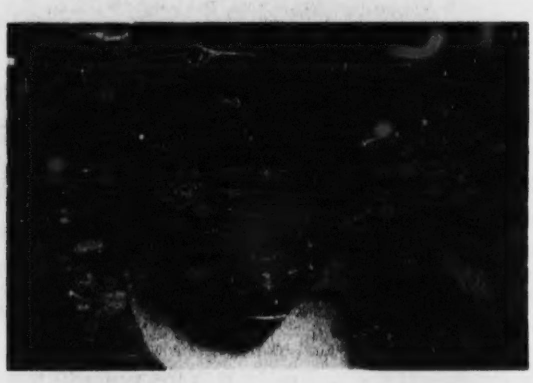
FIGURE 18



JOB SHEET #1

3. Place the clutch center onto the clutch pack so that the splines on the clutch center line up with the plates, and to do this, you will have to work the clutch center back and forth. (Figure 19)

FIGURE 19



4. Check the alignment by lifting up the clutch spring bosses on the pressure plate to make sure that all splines have aligned and that the discs and plates move freely. (Figure 20)

(NOTE: Some clutches have alignment marks that may be dots or arrows, and the clutch center will go on only one way.)

FIGURE 20

5. Hold the outer firmly and turn the clutch center to make sure it turns with a slight amount of drag.

6. Install the bushings, bearings, and washers back into the clutch assembly or onto the shaft in precise order.

7. Place the clutch assembly onto the shaft and align the splines on the clutch center with the clutch shaft, and the gear teeth on the clutch outer with the drive gear.

(NOTE: If you're working with a kick starter idler gear, you may have to turn the gear to get it to properly align.)

JOB SHEET #1

8. Replace the clutch nut locking device and the clutch nut, or the snap-ring. (Figure 21)

FIGURE 21

9. Torque the clutch nut to specifications from the service manual, and enter the information on your service log.

10. Bend the locking tab into position onto the clutch nut with a pair of pliers.

    (CAUTION: Do not try to bend the tab into place with a screwdriver because it will put too much pressure on the clutch spring bosses and break them.)

11. Check to make sure the clutch assembly turns freely with a slight drag.

12. Install the clutch springs onto their bosses and then install the clutch lifter plate. (Figure 22)

FIGURE 22

13. Install the lifter plate bolts finger tight.

JOB SHEET #1

14. Replace the oil rotor if it was removed. (Figure 23)

FIGURE 23

15. Tighten the lifter plate bolts no more than two turns each in a sequence that will assure the lifter plate will be pulled down evenly.

16. Torque lifter plate bolts to specifications.

☐ Have your instructor check your work.

17. Install the clutch cover and torque all bolts to specifications.

    (NOTE: If the tachometer drive gear or other gears are housed in the clutch cover, make sure everything is properly aligned.)

18. Install the kick starter arm.

19. Install the foot peg and exhaust pipe.

20. Reconnect the clutch cable, and adjust free play in the clutch cable to specifications outlined in the service manual.

21. Refill the crankcase with oil.

☐ Have your instructor check your work.

22. Start the bike and check the clutch if your instructor tells you to do so.

23. Clean up area and return tools and materials to proper storage.

JOB SHEET #1

Clutch Service Log

1. Clutch plate warpage limits: ____________________

2. Your clutch plate warpage measurements:

	Okay	Not Okay
1.		
2.		
3.		
4.		
5.		
6.		

3. Clutch disc wear limits: ____________________

4. Your clutch disc wear measurements:

1.
2.
3.
4.
5.
6.

5. Clutch spring free length limits: ____________________

6. Your clutch spring free length measurements:

1.
2.
3.
4.
5.
6.

7. Torque specifications for the clutch nut: ____________________

Your Name ____________________ Date ____________

CLUTCHES
UNIT XIII

PRACTICAL TEST #1
JOB SHEET #1 — REMOVE, DISASSEMBLE, INSPECT, AND REASSEMBLE A MOTORCYCLE CLUTCH

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

> **Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.**

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:			YES	NO
1.	Wore safety glasses.	1.	☐	☐
2.	Removed the clutch with proper procedure.	2.	☐	☐
3.	Disassembled the clutch properly.	3.	☐	☐
4.	Cleaned, dried, and inspected clutch parts.	4.	☐	☐
5.	Checked for proper clutch spring free length.	5.	☐	☐
6.	Measured components for wear limits and warpage.	6.	☐	☐
7.	Reassembled clutch with proper procedure.	7.	☐	☐
8.	Installed clutch and reconnected clutch cable.	8.	☐	☐
9.	Checked clutch for proper operation.	9.	☐	☐
10.	Completed clutch service log.	10.	☐	☐
11.	Cleaned area and returned tools to storage.	11.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CLUTCHES
UNIT XIII

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. The residue from clutch disc wear that accumulates in the bottom of a clutch case

_____b. The measured length of a clutch spring under no pressure

_____c. A mating set of inner and outer teeth that fit together to transmit torque from one part to another

_____d. The contact lever bolt that attaches the lever to its mount

_____e. A saucer-shaped washer that insures even distribution of pressure onto the clutch when the clutch nut is torqued down

_____f. A clutch that is immersed in oil to provide cooling and lubrication for moving parts

1. Free length
2. Wet clutch
3. Splines
4. Spring washer
5. Clutch mud
6. Pivot bolt

2. Match major clutch parts with their functions.

_____a. A slotted housing that is splined to the clutch discs to transmit torque from the engine to the clutch discs

_____b. The moveable part of the clutch that permits the clutch to be engaged or released

_____c. Lightweight aluminum plates coated with a material that causes friction

_____d. Steel discs positioned between the clutch discs to transmit torque from the clutch outer to the clutch center

_____e. A hub splined to the clutch plates and to the clutch shaft to transmit torque from the clutch plates to the clutch shaft

_____f. Stiff, short springs that provide the pressure needed to squeeze the clutch discs and plates together

1. Clutch plates
2. Pressure plate
3. Clutch springs
4. Clutch outer housing
5. Clutch center hub
6. Clutch discs

TEST

3. Complete statements concerning clutch operations by inserting the word(s) that best completes each statement.

   a. A motorcycle clutch usually operates with a lever attached to a cable which is attached to another lever attached to the clutch ____________ mechanism.

   b. When the clutch lever is depressed on the handlebars, mechanical force is transmitted through the release mechanism where it pushes or pulls the clutch lifter plate that depresses the clutch springs and allows the clutch plates and clutch discs to ____________ and ____________ one within the other.

   c. An activated clutch permits engine torque to be disconnected from the ____________ train to the ____________ drive.

   d. When the clutch lever is released, the clutch springs move the pressure plate into the clutch discs and plates, squeeze them together to cause friction between the clutch center and clutch outer to transmit ____________ from the ____________ to the final drive.

4. Select true statements concerning clutch discs and plates by placing an "X" beside each statement that is true.

   _____a. Clutch plates sometimes have minor differences and must be assembled in proper order to insure proper clutch operations.

   _____b. Clutch discs sometimes have minor differences too and must also be assembled in proper order to insure proper clutch operations.

   _____c. Clutch plates may vary in thickness, have oil holes drilled in them, or be slightly saucer shaped.

   _____d. Clutch discs may have alternating directional grooves to force oil out or to pull oil in.

   _____e. Clutch discs may be of the same thickness but vary in width or may vary in both thickness and width.

   _____f. It is essential to install clutch plates and clutch discs in their proper order, but plates and discs can face any direction.

5. Complete statements concerning other clutch parts by inserting the word(s) that best completes each statement.

   a. Clutch release bearings are placed on clutches to allow the clutch to ____________ and the clutch release mechanism to remain stationary and functions only when the clutch is ____________.

   b. Bushings, collars, and washers are used to space clutch components apart so that components can ____________ freely.

   c. Clutch spring bolts that go through the lifter plate should always be removed by turning the single bolts no more than two turns at a time, and in a sequence that will allow spring pressure to be released ____________ on the pressure plate lift bosses.

TEST

d. Clutch spring bolts that go through the lifter plate should always be installed by turning the single bolts no more than two turns at a time, and in a sequence that will allow spring pressure to be ____________ evenly on the pressure plate lift bosses.

e. During removal, gaskets or O-rings on clutch covers seldom break, but if they do, ____________ surfaces should be cleaned and a new gasket or O-ring installed.

6. Select true statements concerning guidelines for clutch service by placing an "X" beside each statement that is true.

_____a. Clutch plates are made of steel and seldom wear out, but they often warp because of excess heat and should always be checked for roundness when servicing a clutch.

_____b. When a clutch will not disengage completely, it's a good indication that the clutch plates are warped, causing difficult shifting and a tendency for the motorcycle to creep forward even when the clutch is disengaged.

_____c. When a clutch slips during acceleration, it is an indication of worn clutch discs, weak springs, or improper clearance on the adjustor screw.

_____d. When a clutch slips or won't release, always check the clutch plates first.

_____e. Wear limit on a single clutch disc is less than .05 mm and although that seems slight, when wear is multiplied by the total number of discs in a clutch, the wear becomes significant.

_____f. Spring free length should always be checked, and if only one of the spring free lengths is short of specified limits, replace it but reuse the other springs.

_____g. Even though only one clutch spring free length may be short, all springs in the clutch should be replaced to assure even pressure at all points of the pressure plate.

_____h. New clutch discs should be thoroughly lubricated in engine oil before assembly.

_____i. Clutch separators are sometimes rubber O-rings or wavy steel bands that fit between the clutch plates to insure complete disengagement of the clutch.

_____j. When a clutch lever will not release freely, check for a dirty or rusted clutch lever.

(NOTE: If the following activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

7. Demonstrate the ability to remove, disassemble, inspect, and reassemble a motorcycle clutch. (Job Sheet #1)

CLUTCHES
UNIT XIII

ANSWERS TO TEST

1. a. 5
   b. 1
   c. 3
   d. 6
   e. 4
   f. 2

2. a. 4
   b. 2
   c. 6
   d. 1
   e. 5
   f. 3

3. a. Release
   b. Separate, turn
   c. Power, final
   d. Power, engine

4. a, b, c, d, e

5. a. Spin, released
   b. Turn
   c. Evenly
   d. Developed
   e. Mating

6. b, c, e, g, h, i, j

7. Performance skills evaluated on practical tests

STARTING SYSTEMS
UNIT XIV

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the types of starting systems found on motorcycles and ATV's. The student should also be able to list service guidelines for kick starters, electric starters, and recoil starters, and service a recoil starter. These competencies will be evidenced by correctly completing the procedures outlined in the job sheet and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to starting systems with their correct definitions.
2. Complete statements concerning kick starters.
3. Select true statements concerning electric starters.
4. Complete statements concerning recoil starters.
5. Demonstrate the ability to service a recoil starter. (Job Sheet #1)

STARTING SYSTEMS
UNIT XIV

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheet.

G. Demonstrate the operation of a kick starter.

H. Show examples of electric starting system reduction systems and explain how they work.

I. Talk about starter clutches and their various locations on different models of motorcycles and ATV's.

J. Impress upon students the importance of learning to service a recoil starter safely, and remind them that ATV's and small engine power equipment repair is becoming part of motorcycle service.

K. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Hires, Bill, Mark Taylor, and Mike Bundy. *Small Engine Repair Two-Stroke and Four-Stroke Cycle.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1985.

C. *Honda Shop Manual '78-'81 CB/CM400's.* Gardena, CA: Honda Motor Co., Ltd., 1980.

D. *Motorcycle Technician's Handbook.* Cypress, CA: Yamaha International Corporation, 1983.

STARTING SYSTEMS
UNIT XIV

INFORMATION SHEET

I. **Terms and definitions**

A. Burring — Damage to metal parts caused by the hammering impact of ratchets against a starter cup or starter drive when the ratchets fail to retract while the engine is running

B. Galling — The transfer of metal from one part to another because of extreme heat or pressure caused by lack of lubrication

C. Thrust spring — A spring that helps create the friction required to extend and retract ratchets

II. **Kick starters**

A. Kick starters are used on many motorcycles as the primary means of starting the engine.

B. Kick starter components include (Transparency 1):

1. Kick starter pedal
2. Kick starter shaft
3. Kick starter return spring
4. Kick starter ratchet
5. Ratchet guide plate
6. A pinion gear

C. Kick starters seldom need servicing, and when they do, the problem is usually improper placement of the ratchet on the kick starter spindle in relation to the proper return spring tension.

D. Most kick starter ratchets have a mark or dot that must be aligned with the return spring hole in the kick starter shaft.

III. **Electric starters** (Transparency 2)

A. Electric starters are used on most street bikes as the primary means of starting the engine.

B. Electric starters use a small DC motor that spins rapidly and uses a gear reduction in the starter or a chain-and-sprocket reduction to multiply torque and start the engine.

INFORMATION SHEET

C. The most common problem with electric starting systems occurs in the starter clutch.

D. When the starter motor turns but the engine will not crank, it means that the starter clutch is defective.

E. Starting clutches must be replaced as complete assemblies, and normal service procedures are easy to follow.

IV. **Recoil starters (Transparency 3)**

A. Recoil starters are used as the primary means of starting small ATV's and almost all power equipment that uses a small gasoline engine.

B. Recoil starters service usually involves replacing a broken rope or a broken return spring.

C. The return spring is tightly wound and has to be removed with great care or it can jump out of the housing and injure you or cause you to injure yourself.

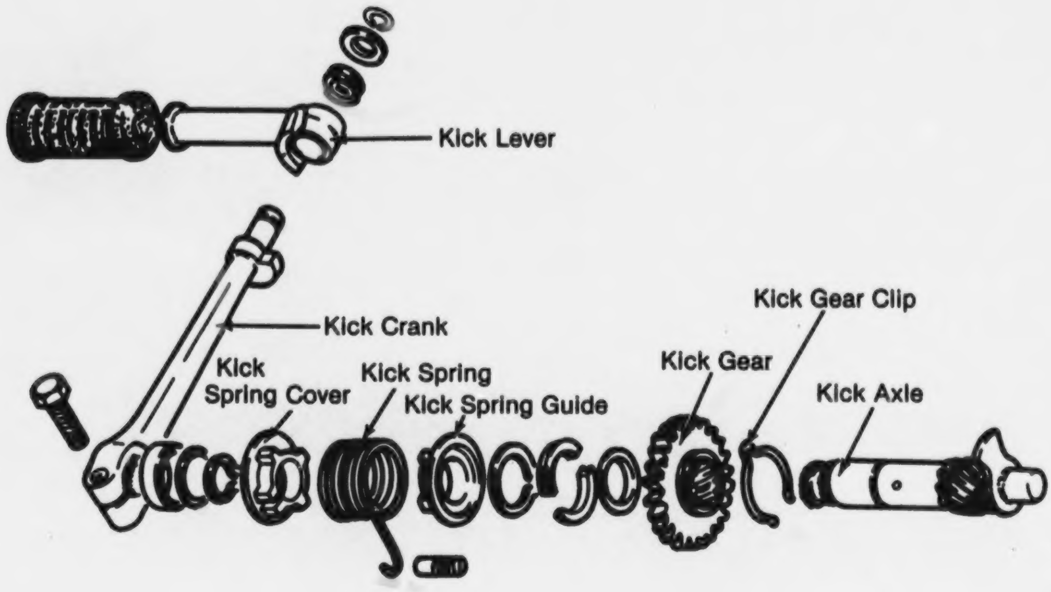
D. When a new rope is installed, there must be enough rope to fill the pulley, but not an excess of rope that would cause the starter to bind.

E. Starter rope is always a special high-strength rope designed to fit the pulley, and substitute replacements will break.

F. There are two different knots that should be tied in a starting rope:

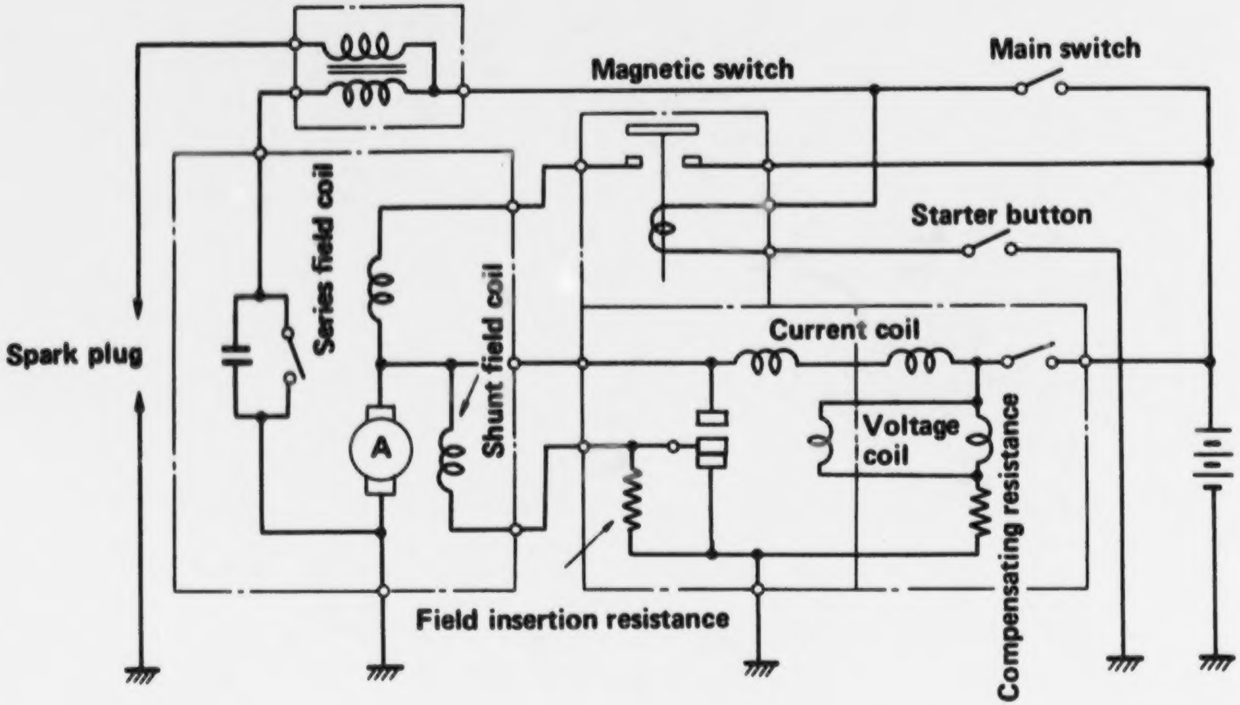
1. A single overhand knot should be tied on the starter pulley end of the rope because the clearance there is limited and larger figure-eight knot will not fit into the housing.
2. A figure-eight knot should be tied where the rope fits into the handle to provide a size that will not pull through the handle of the rope and give added security.
3. In both cases, the rope should be cut about 12 mm beyond the knot and the rope end singed to prevent unraveling, but the rope should not be cut flush with the knot or it will pull through the knot.

Kick Starter Components


Kick Lever
Kick Crank
Kick Spring Cover
Kick Spring
Kick Spring Guide
Kick Gear
Kick Gear Clip
Kick Axle

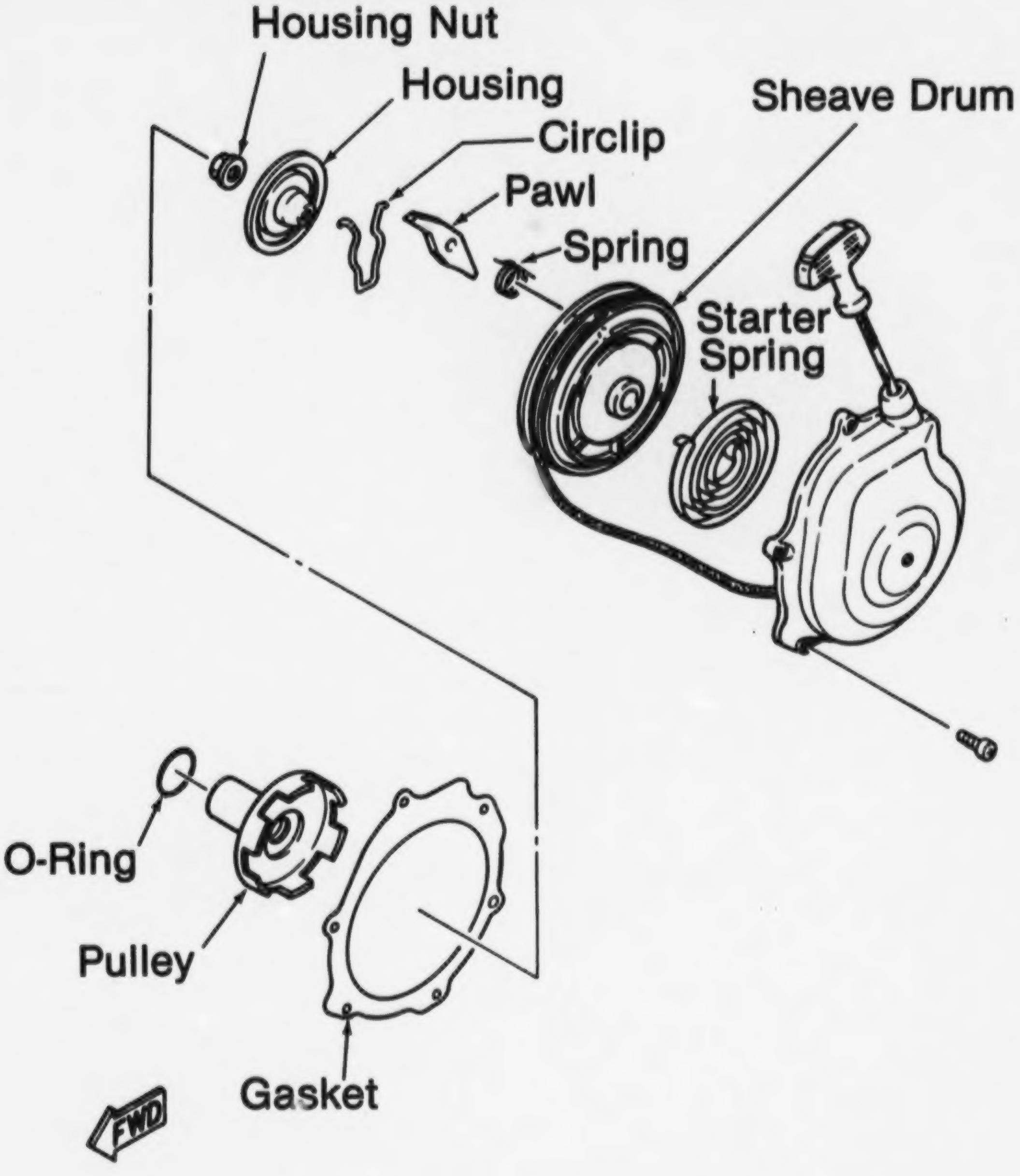
Courtesy Yamaha Motor Corporation, U.S.A.

Electric Starter Schematic


Magnetic switch
Main switch
Starter button
Series field coil
Shunt field coil
Spark plug
A
Current coil
Voltage coil
Compensating resistance
Field insertion resistance

Courtesy Yamaha Motor Corporation, U.S.A.

Recoil Starter Components


Housing Nut
Housing
Circlip
Sheave Drum
Pawl
Spring
Starter Spring
O-Ring
Pulley
Gasket
FWD

Courtesy Yamaha Motor Corporation, U.S.A.

STARTING SYSTEMS
UNIT XIV

JOB SHEET #1 — SERVICE A RECOIL STARTER

A. Tools and materials

1. Vehicle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Snap-ring pliers
6. Grease
7. Safety glasses

B. Routine #1 — Removing and disassembling the recoil starter

1. Put on safety glasses.
2. Secure the vehicle in an upright position.
3. Remove the gear shift pedal, if necessary.
4. Remove the bolts attaching the recoil starter.
5. Remove the recoil starter and place it on a workbench.
6. Remove the cap that covers the rope knot in the handle, and then pull the starting rope out of the handle. (Figure 1)

FIGURE 1

JOB SHEET #1

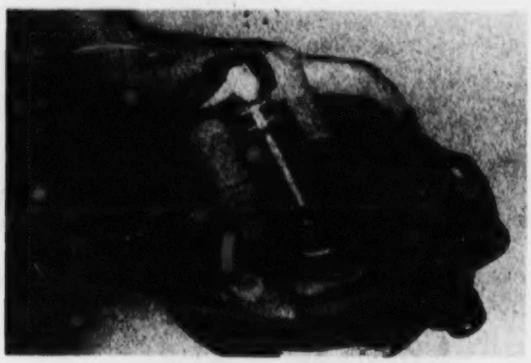
7. Hold the recoil mechanism with one hand as you cut the knot off the rope with the other hand using a knife or a pair of side cutters. (Figure 2)

FIGURE 2

8. Remove the handle and permit the spring in the recoil mechanism to slowly unwind.

9. Remove the nut or the circlip from the ratchet cover, paying attention to placement of the washers because they must be put back in the same places. (Figure 3)

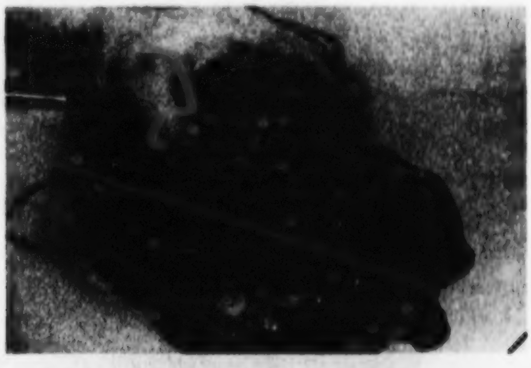
FIGURE 3



JOB SHEET #1

10. Remove the ratchet cover. (Figure 4)

FIGURE 4



11. Remove the ratchets. (Figure 5)

(NOTE: The ratchets may have springs attached, so be sure to note how the springs are attached so you'll get them back properly.)

FIGURE 5

12. Remove the ratchet return spring if there is one.

13. Remove the thrust spring and thrust washer. (Figure 6)

FIGURE 6

JOB SHEET #1

14. Turn the starter drive pulley in the opposite direction that the engine turns.

15. Disengage the return spring underneath the starter drive pulley.

    (CAUTION: If you don't disengage the return spring before removing the starter drive pulley, the spring will unwind rapidly and possibly fly out of the housing and injure you.)

16. Remove the starter drive pulley carefully. (Figure 7)

FIGURE 7

17. Pick the housing up in your hand, turn it upside down, and lightly tap it on the floor to remove the starter return spring. (Figure 8)

FIGURE 8

JOB SHEET #1

18. Remove the rope from the starter drive pulley. (Figure 9)

FIGURE 9

19. Remove any rubber dust covers from the starter housing.

20. Wash all parts in solvent and dry them with compressed air.

☐ Have your instructor check your work.

C. Routine #2 — Inspecting and reassembling the recoil starter

1. Leave your safety glasses on.

2. Inspect the starter cup which remained on the engine for damage or wear where the ratchets contact the starter cup. (Figure 10)

FIGURE 10

3. Inspect the starter cup for cracks which could appear on the outer rim of the starter cup.

4. Check with your instructor if you find starter cup damage because it may need to be replaced.

JOB SHEET #1

5. Inspect the ratchets and ratchet cover for wear which could appear as burring at points where they contact the starter cup and ratchet cover.

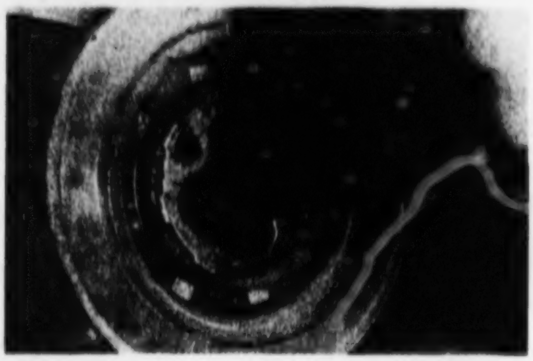
6. Inspect all the springs for wear or damage to any ends that have hooks on them. (Figure 11)

   (NOTE: The hooked end of the return spring is usually the problem area and frequently requires a new return spring.)

   FIGURE 11

7. Inspect the starter drive pulley for damage where the ratchets sit, and look for signs of burring at the same points. (Figure 12)

   FIGURE 12

JOB SHEET #1

8. Check the bore of the starter drive pulley where it fits onto the shaft in the housing for signs of wear or galling from lack of lubrication. (Figure 13)

FIGURE 13

9. Inspect the starter housing for cracks around the attaching bolts and the starter drive pulley shaft for looseness or signs of galling. (Figure 14)

FIGURE 14

10. Inspect the return spring attaching point in the starter housing to make sure it isn't broken. (Figure 15)

FIGURE 15

JOB SHEET #1

11. Inspect the starter rope for signs of fraying, especially near the end where the rope attaches to the handle. (Figure 16)

FIGURE 16

☐ Have your instructor check your work.

12. Grease the area where the starter return spring goes into the starter housing.

13. Grease the starter drive shaft. (Figure 17)

FIGURE 17

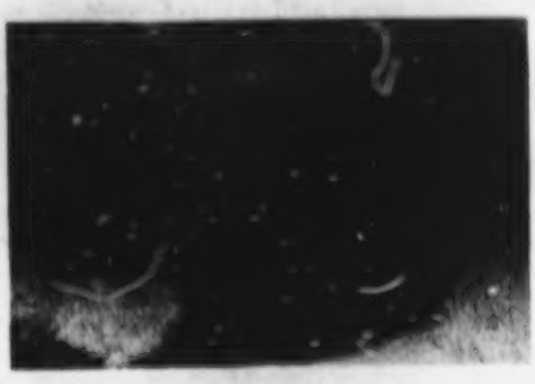
14. Grease the starter drive pulley bore and the ratchet seats.

JOB SHEET #1

15. Attach the outer end of the starter return spring into the starter housing so that the open end of the outer hook faces the direction that the engine will turn. (Figure 18)

    (NOTE: This is to assure that the spring will be wound in the right direction.)

FIGURE 18



16. Use both hands to wind the spring into position in the starter housing. (Figure 19)

    (NOTE: At first, this will seem difficult because the spring will want to pop out if you don't hold it in position, so be sure to use both hands and be patient until you get the hang of it.)

FIGURE 19

17. Tie an overhand knot in one end of the starter rope, and feed the rope through the hole in the starter drive pulley so that the knot comes up flush on the inside of the pulley.

JOB SHEET #1

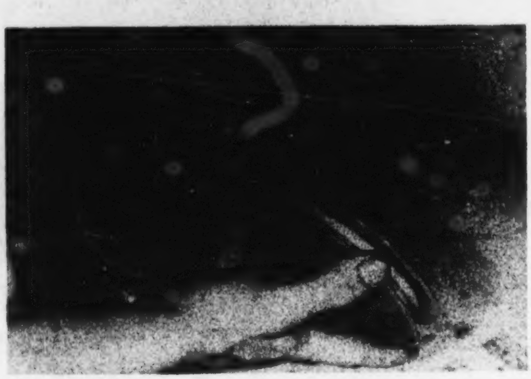
18. Check the rope at the knot and cut off any excess rope to assure the starter rope will not interfere with any moving parts, and then singe the end of the rope. (Figure 20)

    (NOTE: Do not cut the rope flush with the knot or the rope will quickly come untied; leave at least 12 mm of rope to allow the knot to firmly seat.)

    FIGURE 20

19. Wind the rope into the pulley in the opposite direction that the engine turns until the pulley is filled with rope. (Figure 21)

    FIGURE 21

JOB SHEET #1

20. Hook the rope into the cutout in the edge of the pulley. (Figure 22)

FIGURE 22

21. Install the pulley into the starter housing, and turn it so that it will engage the hook of the return spring. (Figure 23)

FIGURE 23

22. Install the ratchets and springs, and then the thrust spring and thrust washer. (Figure 24)

FIGURE 24

JOB SHEET #1

23. Install the ratchet cover, and be sure to also put the return spring in place.

24. Replace the nut or circlip onto the ratchet cover, and if it is a nut, torque to specifications. (Figure 25)

FIGURE 25

25. Take the free end of the rope and turn the starter drive pulley two or three turns in the opposite direction the engine turns. (Figure 26)

FIGURE 26

26. Hold the starter drive pulley in position and feed the free end of the rope through the rope guide in the starter housing. (Figure 27)

FIGURE 27

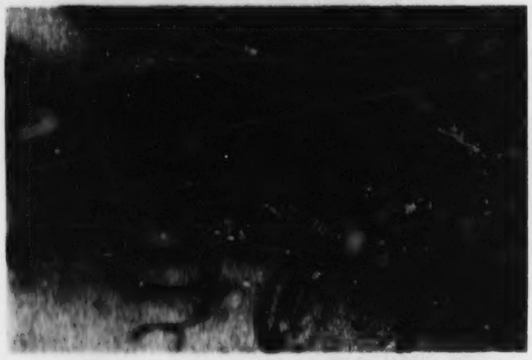
JOB SHEET #1

27. Get hold of the free end of the rope and pull it out of the rope guide at least a foot so you can work with it, and be sure to hang on to the rope or the whole thing will unwind.

28. Replace the rubber dust cover by sliding it down over the rope and fitting it into place, and hang on to the rope.

29. Tie a loose knot in the rope near the housing to prevent the rope from retracting into the housing while you're installing the handle. (Figure 28)

FIGURE 28



30. Install the handle onto the rope and tie a knot in the end of the rope. (Figure 29)

FIGURE 29

31. Pull the knot down into the handle until it firmly seats.

32. Untie the loose knot near the housing.

33. Check the operation of the starter to make sure the rope pulls out all the way and returns the handle firmly to its position on the housing.

JOB SHEET #1

34. Cut the end of the rope off, singe it, and then put the cap back on the handle. (Figure 30)

(CAUTION: Don't cut the rope off flush with the knot; leave about 12 mm of rope so the knot will firmly seat.)

FIGURE 30

35. Work the rope back and forth and observe the ratchet assembly to see that it extends and retracts the ratchets properly.

36. Install the starter assembly onto the vehicle.

37. Install the gear shift pedal.

38. Check the operation of the starter assembly.

☐ Have your instructor check your work.

39. Clean up area and return tools and materials to proper storage.

STARTING SYSTEMS
UNIT XIV

PRACTICAL TEST #1
JOB SHEET #1 — SERVICE A RECOIL STARTER

Student's name ______________________ **Date** ____________

Evaluator's name ______________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed rope and starter assembly properly.	2.	☐	☐
3. Permitted recoil mechanism to unwind slowly.	3.	☐	☐
4. Disassembled recoil starter.	4.	☐	☐
5. Inspected components and replaced as required.	5.	☐	☐
6. Placed new recoil spring properly in place.	6.	☐	☐
7. Wound pulley properly.	7.	☐	☐
8. Reassembled starter.	8.	☐	☐
9. Secured rope in handle and replaced starter.	9.	☐	☐
10. Checked starter for proper operation.	10.	☐	☐
11. Cleaned area and returned tools to storage.	11.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

STARTING SYSTEMS
UNIT XIV

NAME ______________________

TEST

1. Match terms related to starting systems with their correct definitions.

_____a.	Damage to metal parts caused by the hammering impact of ratchets against a starter cup or starter drive when the ratchets fail to retract while the engine is running	1. Galling
_____b.	The transfer of metal from one part to another because of extreme heat or pressure caused by lack of lubrication	2. Thrust spring
_____c.	A spring that helps create the friction required to extend and retract ratchets	3. Burring

2. Complete statements concerning kick starters by inserting the word(s) that best completes each statement.

   a. Kick starters are used on many motorcycles as the ____________ means of starting the engine.

   b. Kick starter components include:

      1) Kick starter ____________
      2) Kick starter ____________
      3) Kick starter ____
      4) Kick starter ____
      5) Ratchet ____ plate
      6) A ____ gear

   c. Kick starters seldom need servicing, and when they do, the problem is usually improper placement of the ____________ on the kick starter spindle in relation to the proper return spring tension.

   d. Most kick starter ratchets have a ____________ or ____________ that must be aligned with the return spring hole in the kick starter shaft.

TEST

3. Select true statements concerning electric starters by placing an "X" beside each statement that is true.

_____a. Electric starters are used on most street bikes as the primary means of starting the engine.

_____b. Electric starters use a small DC motor that spins rapidly and uses a gear reduction in the starter or a chain-and-sprocket reduction to multiply torque and start the engine.

_____c. The most common problem with electric starting systems occurs in the switch.

_____d. When the starter motor turns but the engine will not crank, it means that the starter motor is defective.

_____e. Starting clutches must be replaced as complete assemblies, and normal service procedures are easy to follow.

4. Complete statements concerning recoil starters by inserting the word(s) that best completes each statement.

a. Recoil starters are used as the primary means of starting small ATV's and almost all power equipment that uses a small ____________ engine.

b. Recoil starters service usually involves replacing a broken ____________ or a broken ____________ ____________.

c. The ____________ ____________ is tightly wound and has to be removed with great care or it can jump out of the housing and injure you or cause you to injure yourself.

d. When a new rope is installed, there must be enough rope to fill the ____________, but not an excess of rope that would cause the starter to bind.

e. Starter rope is always a special ____________ ____________ rope designed to fit the pulley, and substitute replacements will break.

f. There are two different knots that should be tied in a starting rope:

1) A ____________ ____________ knot should be tied on the starter pulley end of the rope because the clearance there is limited and a larger ____________ ____________ knot will not fit into the housing.

2) A ____________ ____________ knot should be tied where the rope fits into the handle to provide a size that will not pull through the handle of the rope and give added security.

3) In both cases, the rope should be cut about 12 mm beyond the knot and the rope end ____________ to prevent unraveling, but the rope should not be cut flush with the knot or it will pull through the knot.

TEST

(NOTE: If the following activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

5. Demonstrate the ability to service a recoil starter. (Job Sheet #1)

STARTING SYSTEMS
UNIT XIV

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 2

2. a. Primary
   b. 1) Pedal
      2) Shaft
      3) Return spring
      4) Ratchet
      5) Guide
      6) Pinion
   c. Ratchet
   d. Mark, dot

3. a, b, e

4. a. Gasoline
   b. Rope, return spring
   c. Return spring
   d. Pulley
   e. High-strength
   f. 1) Single overhand, figure-eight
      2) Figure-eight
      3) Singed

5. Performance skills evaluated on practical test

BASIC IGNITION TUNE-UP
UNIT XV

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss types of ignition systems and guidelines for their service. The student should also be able to replace the points and condenser on a breaker-point ignition system and adjust and verify ignition timing. These competencies will be evidenced by correctly completing the procedures outlined in the job sheet and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to basic ignition tune-up with their correct definitions.
2. Complete statements concerning electronic ignition systems.
3. Select true statements concerning breaker-point ignition systems.
4. Select true statements concerning energy transfer ignition systems.
5. Complete statements concerning guidelines for ignition service.
6. Demonstrate the ability to service a breaker-point ignition system. (Job Sheet #1)

BASIC IGNITION TUNE-UP
UNIT XV

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Discuss unit and specific objectives.

D. Discuss information sheet.

E. Demonstrate and discuss the procedures outlined in the job sheet.

F. Demonstrate the type of wire terminal modification outlined in the job sheet.

G. Show students how to perform static ignition timing with an audio timing tester, and how to use a timing light to verify ignition timing.

H. Demonstrate condenser and point replacement.

I. Use video tapes as appropriate for visual reinforcement of objectives and job sheets. S1004—*Four-Stroke Engine Tune-Up Service*; S1005—*Two-Stroke Engine Tune-Up Service*; S1011—*Two-Stroke Engine Tune-Up Service*; S1610—*TPI: Troubleshooting Made Easy*; S1612—*CDI: A Practical Approach* are available at an educational discount in 1/2" VHS or Beta video tapes from:

American Honda Motors Co., Inc.
Motorcycle VoTech
100 West Alondra Blvd.
Gardena, CA 90248-2702

J. Other videos to help reinforce this unit include *Ignition Systems* and *Spark Plugs*. These videos are available in 3/4" U-Matic, 1/2" Beta I, 1/2" Beta II, or 1/2" VHS formats from:

Kawasaki Motors Corp., U.S.A.
Service Training
9950 Jeronimo Road
Irvine, CA 92718-2016

K. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Hires, Bill, Mark Taylor, and Mike Bundy. *Small Engine Repair Two-Stroke and Four-Stroke Cycle.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1985.

C. *Motorcycle Technician's Handbook.* Cypress, CA: Yamaha International Corporation, 1983.

BASIC IGNITION TUNE-UP
UNIT XV

INFORMATION SHEET

I. **Terms and definitions**

A. Breaker points — A set of mechanical contacts that open and close to provide a precisely timed spark to the spark plug

B. Condenser — A component of a points ignition system that regulates current in such a way that it protects the ignition points from excessive arcing and discharges to boost ignition spark

C. Point cam — A lobe on a camshaft that opens the ignition points

D. Point cam lubricant — A special grease that resists high temperature and retains its viscosity to lubricate the points rubbing block

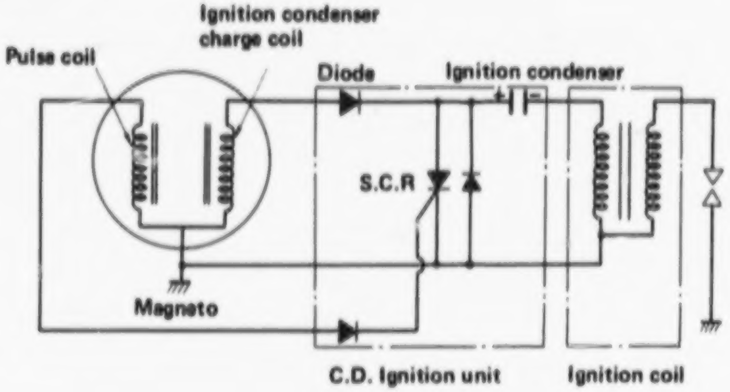
E. Dynamic timing — Timing the ignition with the engine running

F. Static timing — Timing the ignition with the engine not running

II. **Electronic ignition systems** (Figure 1)

A. Electronic ignition systems are also called CDI, capacitor discharge ignition, and/or transistorized ignition.

FIGURE 1



Courtesy Yamaha Motor Corporation, U.S.A.

B. Electronic ignition systems are the most widely used ignitions systems because they perform well and are virtually maintenance free.

INFORMATION SHEET

C. With some electronic ignition systems, the ignition timing is preset at the factory and cannot be changed.

D. Verification of ignition timing is primarily the only service that can be performed on some electronic ignition systems.

E. When an electronic ignition system is not working right, it is usually a defective pulser generator, a bad spark unit, or an ignition coil, and the bad component has to be replaced.

F. The most likely problem that can happen with an electronic ignition is that the spark unit will go bad, and replacing the spark unit will correct electronic ignition problems.

G. Dirty connections are another common problem with electronic ignitions.

III. Breaker-point ignition systems

A. Breaker-point ignition systems are also called magneto ignitions or ET (energy transfer) ignitions.

B. Breaker-point ignition systems have been pretty much phased out, but technicians will still run into them often and need to become proficient at servicing these older type ignition systems.

C. Breaker-point ignition service is almost always delegated to entry-level technicians.

D. Breaker-point ignition systems require periodic service and replacement of points and condensers to maintain engine performance.

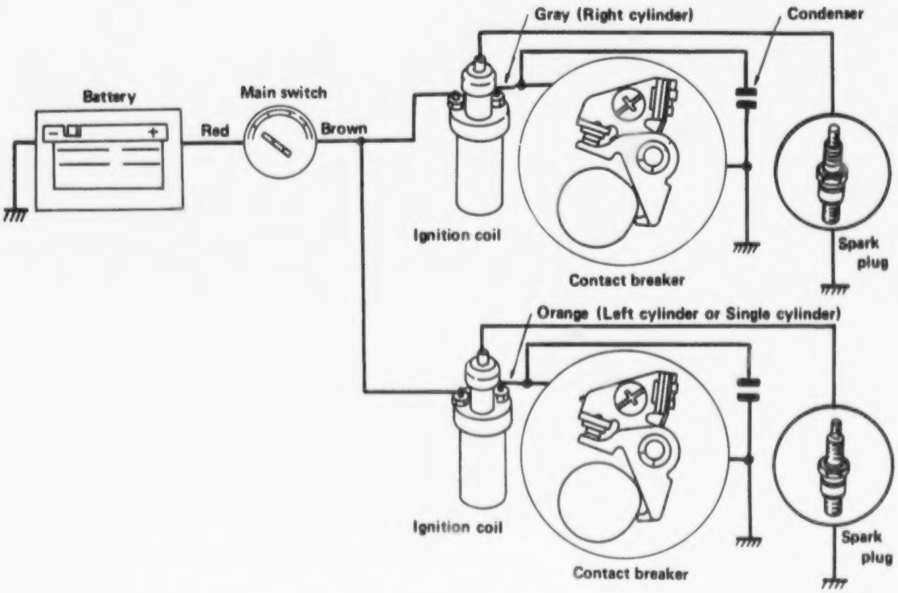
E. A breaker-point ignition system consists of (Figure 2):

1. A point cam to open the points
2. A spring-loaded breaker point assembly
3. A condenser
4. An ignition coil

INFORMATION SHEET

5. A battery and coil

FIGURE 2


Gray (Right cylinder)
Condenser
Battery
Main switch
Red
Brown
Ignition coil
Contact breaker
Spark plug
Orange (Left cylinder or Single cylinder)
Ignition coil
Contact breaker
Spark plug

Courtesy Yamaha Motor Corporation, U.S.A.

F. When points are replaced, the condenser should also be replaced.

G. Some breaker-point ignition systems require a battery as a power source and some do not have battery power, but both systems are serviced the same.

IV. **Energy transfer ignition systems** (Figure 3)

A. Energy transfer ignition systems, ET's, can be transistorized or work with points and a condenser.

B. ET's have a primary ignition coil which is the power source and do not require a battery or outside power source as most other ignition systems do.

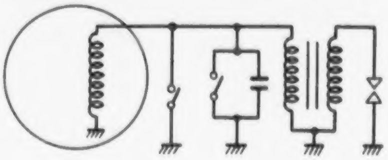
C. Most dirt bikes and racing models of ATV's have ET ignition systems because they are self-contained, waterproof, and virtually indestructible.

INFORMATION SHEET

D. If an ET system is transistorized, it is serviced as an electronic ignition, and if the ET system has breaker points and a condenser it is serviced like a breaker-point ignition system.

E. The basic difference between an ET system and an electronic system is that the ET system works on alternating current and the electronic ignition works on a combination of alternating and direct current.

FIGURE 3



Courtesy Yamaha Motor Corporation, U.S.A.

V. **Guidelines for ignition service**

A. When an ignition system is driven by a camshaft, the cam chain must always be adjusted before ignition service is started.

B. New spark plugs of the correct heat range should be installed when the ignition is tuned up, and spark plug gap should always be carefully checked.

C. When replacing ignition points, always replace the condenser too.

D. Dynamic ignition timing should always be verified with a timing light while the engine is running at normal operating rpm, or as specified in the service manual.

E. To prevent premature rubbing block wear and ignition timing changes, always lubricate the point cam with a quality point cam lubricant.

F. When servicing a breaker-point ignition system, remember that spark occurs at the instant the points open, not when the points close.

G. Point gap regulates the amount of time that the points are closed so that a circuit can be completed and allow a magnetic field to build up in the ignition coil.

H. When points open, it breaks the circuit causing the magnetic field in the coil to collapse and produces a high voltage spark that goes to the spark plug.

BASIC IGNITION TUNE-UP
UNIT XV

JOB SHEET #1 — SERVICE A BREAKER-POINT IGNITION SYSTEM

A. Tools and materials

1. Vehicle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Audio timing tester/ohm meter
6. Timing light
7. Flywheel puller
8. Soldering gun and solder
9. Feeler gauge
10. Point cam lubricant
11. Safety glasses

B. Routine #1 — Inspecting and removing breaker points and condenser

1. Put on safety glasses.
2. Secure the vehicle in an upright position.
3. Remove the points cover or pull the flywheel to expose the breaker points. (Figure 1)

FIGURE 1

JOB SHEET #1

4. Open the breaker points by hand and inspect the breaker contacts for pitting, burning, or wear, and if any of these conditions are present the breaker points and condenser have to be replaced. (Figure 2)

   (NOTE: If the motorcycle has more than ten thousand miles on it, the points and condenser should be replaced even though wear doesn't appear to be severe.)

   FIGURE 2

5. Look at the wire terminals attached to the breaker points and note the direction that the wires attach to the points. (Figure 3)

   (NOTE: There may be one or two wires, but in either case, they must be reconnected to the points precisely to permit proper clearance and wire routing.)

   FIGURE 3

JOB SHEET #1

6. Remove the screws that secure the breaker points to their mounting plates.
7. Remove the nut that attaches the wire(s) to the points. (Figure 4)

FIGURE 4

8. Note the position of the wire in relation to the insulators, washers, and points spring because all of these have to be replaced in precise order or it will short circuit the ignition. (Figure 5)

FIGURE 5

JOB SHEET #1

9. Remove the breaker points. (Figure 6)

FIGURE 6

10. Check the terminal on the breaker point wire and if it is a closed-type terminal, take a pair of side cutters and snip out a center space so it will slide on to the new points screw without having to remove the nut, washers, and insulators.

    (NOTE: This is not only a time saving modification, it will assure that washers and insulators stay in the proper order on the new point set.)

11. Remove the condenser with the appropriate procedure:

    a. If the condenser is inside the flywheel, you will probably have to unsolder the wires that are attached to the condenser. (Figure 7)

FIGURE 7

JOB SHEET #1

b. Heat the solder and pull each wire out with a pair of needle-nose pliers, being very careful not to cut the wires because they are a precise length and must remain that length and be routed in the same locations. (Figure 8)

FIGURE 8

c. Once the wires are safely removed, remove the mounting screw and lift the condenser out. (Figure 9)

FIGURE 9

d. If the condenser is mounted on the frame or near the coils, unscrew the mounting bolt and disconnect the plug in terminals on the end of the condenser.

☐ Have your instructor check your work.

C. Routine #2 — Installing new breaker points and condenser

1. Leave your safety glasses on.

JOB SHEET #1

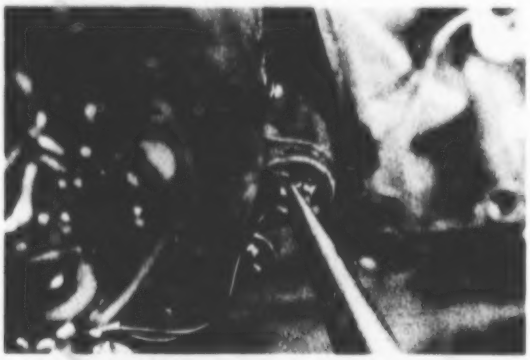
2. Install the new condenser with the appropriate procedure:

   a. If the condenser is mounted on the frame near the coils, simply screw the new condenser into place and attach the wires as they were on the original condenser.

   b. If the condenser is mounted inside the flywheel, screw the new condenser in place.

   c. Attach the wires to the condenser by bending the solder tabs onto the bare wires. (Figure 10)

FIGURE 10



   d. Bend the other tabs onto the insulated portion of the wires to hold them in position for soldering. (Figure 11)

FIGURE 11

JOB SHEET #1

e. Heat the connecting points just enough to permit a small amount of solder to attach the wires securely to the condenser, but do not apply too much solder. (Figure 12)

FIGURE 12

f. Allow the soldered connections to cool and then check them by pulling gently on each wire. (Figure 13)

FIGURE 13

g. Remove the felt lubricating pad from the old condenser and place it on the new one and bend the mounting tab into position to secure it.

h. Place a couple of drops of oil on the lubricating pad.

i. Doublecheck all wires for correct routing.

JOB SHEET #1

3. Attach the wires to the ignition points before mounting the points on their base.

4. Make sure the guide pin on the points fits into its guide hole and that the points are seated flat on their base, and then tighten the screws lightly. (Figure 14)

FIGURE 14

☐ Have your instructor check your work.

D. Routine #3 — Timing the ignition

1. Leave your safety glasses on.

2. Time the ignition with the following procedure if the ignition unit is inside the flywheel.

   a. Replace the flywheel, making sure it properly engages the key on the crankshaft.

      (NOTE: The key is very small and fitting the flywheel properly will require some patience, but be sure the flywheel is in the key or the point cam will break when the flywheel is tightened down.)

   b. Torque the flywheel to specifications in the service manual.

   c. Find the wire that goes to the ignition in the flywheel, and disconnect it from the coil.

   d. Attach one lead of an audio timing tester to the wire leading to the magneto.

   e. Attach the other lead of the audio timing tester to a ground on the engine.

   f. Turn the flywheel so that the F mark on the flywheel aligns with the index mark or notch on the engine.

JOB SHEET #1

g. Adjust the ignition point gap so that the points break open at the precise time the F mark aligns with the index mark.

h. Turn the flywheel backwards away from the timing marks, then slowly advance it in the direction it normally turns.

i. Listen for the tone or tone change from the tester that will indicate the points are breaking open precisely at the F mark.

j. Tighten the points mounting screws securely, and recheck the timing.

k. Loosen the points screws and readjust as required.

☐ Have your instructor check your work.

l. Replace the flywheel cover, disconnect the audio timing tester, ad reconnect all wiring.

m. Start the engine if your instructor tells you to.

3. Time the ignition with the following procedure if the ignition unit is not mounted inside the flywheel:

a. Install the wire(s) that goes to the points. (Figure 15)

FIGURE 15

JOB SHEET #1

b. Place the terminal(s) in the correct position and tighten the nut(s). (Figure 16)

FIGURE 16

c. Mount the points, making sure that the guide pin on the points fits into its guide hole and that the points are seated flat on their base.

d. Tighten the points down lightly.

e. If the points are mounted on the camshaft, remove the alternator cover so you can turn the engine at the flywheel.

f. Turn the engine until the point cam lobe opens the points to their widest point.

g. Use a feeler gauge to set the point gap to the specifications in the service manual.

h. Tighten the points mounting screws.

i. If there is more than one set of points, repeat the procedure for the other sets of points.

j. Loosen the base plate screws only enough to allow the points base to be turned.

JOB SHEET #1

k. Attach one lead of an audio timing tester to the points wire screw or the points spring. (Figure 17)

FIGURE 17

l. Attach the other tester lead to a ground on the engine. (Figure 18)

FIGURE 18

m. Turn the flywheel so that the F mark on the flywheel aligns with the index mark or notch on the engine. (Figure 19)

FIGURE 19

JOB SHEET #1

n. Turn the backing plate so that the points break open at the precise time the F mark aligns with the index mark.

o. Tighten the backing plate screws once you have the proper ignition timing. (Figure 20)

FIGURE 20

p. Turn the flywheel backwards then slowly advance it to the F mark, index mark alignment to make sure that the points break open exactly on the F mark.

q. Continue turning the engine to open the points to their widest point, and recheck the point gap with a feeler gauge.

r. If the gap is incorrect, repeat the entire procedure because resetting the point gap will change ignition timing.

s. If the ignition system has more than one set of points, set the point gap on the other set(s) of points as outlined above and adjust the ignition timing on that set of points by moving the auxiliary base plate which that set of points sits on.

☐ Have your instructor check your work.

t. Put a small amount of point cam lubricant or high-heat grease on the end of a screwdriver and dab a small amount of grease on the point cam. (Figure 21)

FIGURE 21

JOB SHEET #1

u. Verify ignition timing with a timing light. (Figure 22)

FIGURE 22

v. Replace all covers.

4. Start the engine if your instructor tells you to.

5. Clean up area and return tools and materials to proper storage.

BASIC IGNITION TUNE-UP
UNIT XV

PRACTICAL TEST #1
JOB SHEET #1 — SERVICE A BREAKER-POINT IGNITION SYSTEM

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

> Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed cover and inspected breaker points.	2.	☐	☐
3. Noted direction of breaker point wires from terminals.	3.	☐	☐
4. Removed breaker points.	4.	☐	☐
5. Removed condenser with proper soldering technique.	5.	☐	☐
6. Replaced breaker points and condenser.	6.	☐	☐
7. Lubricated felt pad on condenser.	7.	☐	☐
8. Adjusted ignition point gap for correct timing.	8.	☐	☐
9. Tightened points mounting screws.	9.	☐	☐
10. Replaced flywheel cover and verified timing.	10.	☐	☐
11. Cleaned area and returned tools to storage.	6.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC IGNITION TUNE-UP
UNIT XV

NAME ____________________

TEST

1. Match terms related to basic ignition tune-up with their correct definitions.

_____a. A set of mechanical contacts that open and close to provide a precisely timed spark to the spark plug

_____b. A component of a points ignition system that regulates current in such a way that it protects the ignition points from excessive arcing and discharges to boost ignition spark

_____c. A lobe on a camshaft that opens the ignition points

_____d. A special grease that resists high temperature and retains its viscosity to lubricate the points rubbing block

_____e. Timing the ignition with the engine running

_____f. Timing the ignition with the engine not running

1. Point cam
2. Static timing
3. Condenser
4. Breaker points
5. Dynamic timing
6. Point cam lubricant

2. Complete statements concerning electronic ignition systems by inserting the word(s) that best completes each statement.

a. Electronic ignition systems are also called CDI, capacitor discharge ignition, and/or __________ __________.

b. __________ __________ __________ are the most widely used ignitions systems because they perform well and are virtually maintenance free.

c. With some electronic ignition systems, the __________ __________ is preset at the factory and cannot be changed.

d. __________ of ignition timing is primarily the only service that can be performed on some electronic ignition systems.

e. When an electronic ignition system is not working right, it is usually a __________ __________ __________, a __________ __________ __________, or an __________ __________, and the bad component has to be replaced.

TEST

f. The most likely problem that can happen with an electronic ignition is that the ____________ ____________ will go bad, and replacing the ____________ ____________ will correct electronic ignition problems.

g. ____________ ____________ are another common problem with electronic ignitions.

3. Select true statements concerning breaker-point ignition systems by placing an "X" beside each statement that is true.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Breaker-point ignition systems are also called magneto ignitions or ET ignitions.

_____b. Breaker-point ignition systems have been pretty much phased out, but technicians will still run into them often and need to become proficient at servicing these older type ignition systems.

_____c. Breaker-point ignition service is almost always delegated to high-level technicians.

_____d. Breaker-point ignition systems require periodic service and replacement of points and condensers to maintain engine performance.

_____e. A breaker-point ignition system consists of:

1) A point cam to close the points

2) A spring-loaded breaker point assembly

3) A condenser

4) An ignition coil

5) A battery and coil

_____f. When points are replaced, the condenser should also be replaced.

_____g. Some breaker-point ignition systems require a battery as a power source and some do not have battery power, but both systems are serviced the same.

TEST

4. Select true statements concerning energy transfer ignition systems by placing an "X" beside each statement that is true.

_____a. Energy transfer ignition systems, ET's, can be transistorized or work with points and a condenser.

_____b. ET's have a primary ignition coil which is the power source and require a battery or outside power source as most other ignition systems do.

_____c. Most dirt bikes and racing models of ATV's have ET ignition systems because they are self-contained, waterproof, and virtually indestructible.

_____d. If an ET system is transistorized, it is serviced as an electronic ignition, and if the ET system has breaker points and a condenser it is serviced like a breaker-point ignition system.

_____e. The basic difference between an ET system and an electronic system is that the ET system works on alternating current and the electronic ignition works on direct current only.

5. Complete statements concerning guidelines for ignition service by inserting the word(s) that best completes each statement.

a. When an ignition system is driven by a camshaft, the cam chain must always be ____________ before ignition service is started.

b. New spark plugs of the correct heat range should be installed when the ignition is turned up, and ____________ ____________ ____________ should always be carefully checked.

c. When replacing ignition points, always replace the ____________ too.

d. Dynamic ignition timing should always be verified with a ____________ ____________ while the engine is running at normal operating rpm, or as specified in the service manual.

e. To prevent premature rubbing block wear and ignition timing changes, always ____________ the point cam with a quality ____________ ____________ ____________.

f. When servicing a breaker-point ignition system, remember that ____________ occurs at the instant the points open, not when the points close.

g. Point gap regulates the amount of time that the points are closed so that a circuit can be completed and allow a ____________ ____________ to build up in the ignition coil

h. When points open, it breaks the ____________ causing the magnetic field in the coil to collapse and produces a high voltage spark that goes to the spark plug.

TEST

(NOTE: If the following activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

6. Demonstrate the ability to service a breaker-point ignition system. (Job Sheet #1)

BASIC IGNITION TUNE-UP
UNIT XV

ANSWERS TO TEST

1. a. 4
   b. 3
   c. 1
   d. 6
   e. 5
   f. 2

2. a. Transistorized ignition
   b. Electronic ignition systems
   c. Ignition timing
   d. Verification
   e. Defective pulser generator, bad spark unit, ignition coil
   f. Spark unit, spark unit
   g. Dirty connections

3. a, b, d, f, g

4. a, c, d

5. a. Adjusted
   b. Spark plug gap
   c. Condenser
   d. Timing light
   e. Lubricate, point cam lubricant
   f. Spark
   g. Magnetic field
   h. Circuit

6. Performance skills evaluated by practical tests

BASIC ENGINE TUNE-UP
UNIT XVI

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the sequence of engine tune-up from changing spark plugs to changing the oil and oil filter. The student should also be able to discuss special tools and equipment needed for an engine tune-up, and procedures for compression and leak-down tests. The student should also be able to adjust valves, adjust carburetors, synchronize carburetors, make a cam chain adjustment, and inspect ignition timing. These competencies will be evidenced by correctly completing the procedures outlined in the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to basic engine tune-up with their correct definitions.
2. Complete statements concerning engine tune-up preparations.
3. Complete statements concerning engine tune-up sequence.
4. Complete statements concerning spark plug inspection.
5. Select true statements concerning valve adjustment.
6. Complete statements concerning cam chain adjustment.
7. Complete statements concerning ignition timing.
8. Complete statements concerning ignition timing marks.
9. Complete statements concerning air filter service.
10. Select true statements concerning crankcase ventilation.
11. Complete statements concerning carburetor adjustment.
12. Complete statements concerning carburetor synchronization.
13. Complete statements concerning oil and filter service.

OBJECTIVE SHEET

14. Select proper shim thicknesses for shim-type valve adjustment. (Assignment Sheet #1)

15. Demonstrate the ability to:

    a. Perform a compression test on a motorcycle engine. (Job Sheet #1)

    b. Perform a leak-down test on a motorcycle engine. (Job Sheet #2)

    c. Adjust the valves on a motorcycle engine. (Job Sheet #3)

    d. Adjust cam chain tension. (Job Sheet #4)

    e. Inspect ignition timing. (Job Sheet #5)

    f. Service an air filter. (Job Sheet #6)

    g. Adjust a motorcycle carburetor using an exhaust gas analyzer. (Job Sheet #7)

    h. Synchronize carburetors on a multi-cylinder motorcycle engine. (Job Sheet #8)

    i. Change engine oil and filter. (Job Sheet #9)

BASIC ENGINE TUNE-UP
UNIT XVI

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information and assignment sheets.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Demonstrate how to use a timing light and discuss the concept of "timing" in general.

H. Demonstrate how to adjust valves of the adjusting screw type and shim type.

I. Demonstrate the proper use of a carb stick in synchronizing carburetors and impress upon students the necessity of working with care when using a carb stick and to make sure they maintain the carb stick in a vertical attitude at all times.

J. Demonstrate both methods of carburetor adjustment.

K. Demonstrate cam chain adjustment.

L. Demonstrate the procedure for making a dry and wet compression test and a leak-down test.

M. Show students the special tools required for engine tune-up and discuss their proper use.

N. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Hires, Bill, Mark Taylor, and Mike Bundy. *Small Engine Repair Two-Stroke and Four-Stroke Cycle.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1985.

C. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics.* New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

D. Johns, Bruce A., and David D. Edmundson. *Motorcycles Fundamentals, Service, Repair.* South Holland, IL: The Goodheart-Willcox Co., Inc., 1984.

BASIC ENGINE TUNE-UP
UNIT XVI

INFORMATION SHEET

I. **Terms and definitions**

A. Blow-by — The combustion pressure that is forced past piston rings and down into the crankcase

B. Carbon monoxide — A poisonous gas produced by the incomplete burning of substances containing carbon

C. Carb stick — A closely-spaced series of four or six glass columns about three feet long with the lower ends submerged in a reservoir of mercury and a hose attached to the other end so it can be attached to a manifold to measure manifold vacuum

D. EPA standards — Standards set by the environmental protection agency to limit the amount hydrocarbons and carbon monoxide that are exhausted by an engine

E. Hydrocarbon — The amount of unburned gasoline or oil vapor exhausted by a running engine

F. Detonation — Engine pings or knocks produced by excessive heat, excessive compression, or gasoline with too low an octane

G. Pre-ignition — Ignition timing that is advanced to a degree that causes pinging or clattering and can result in engine failure

H. Vacuum gauge set — A frame-mounted set of gauges designed to show manifold vacuum on individual cylinders

II. **Engine tune-up preparations**

A. Many motorcycle owners don't understand the mechanics of engine operation and frequently take a bike in for a tune-up when the real problem is mechanical wear or damage.

B. There are some conditions which usually indicate that an engine may need more than a tune-up:

1. An oily exhaust pipe or excessive smoke out the exhaust pipe
2. An air filter that is saturated with engine oil
3. Excessive engine noise
4. Spark plugs that are fouled with oil or burned excessively

INFORMATION SHEET

5. An engine that uses an excessive amount of oil

6. An engine that is missing on one or more cylinders

C. When an engine is suspected of having severe wear or damage, it is recommended that the engine be tested for compression or that a leak-down test be performed to verify problems.

III. **Engine tune-up sequence**

A. Spark plug inspection and replacement — New plugs are almost always required and the old plugs provide clues to indicate the condition of the engine; do this first

B. Valve adjustment — Must be made while the engine is cold, and since it affects individual cylinder performance, it must be done before carburetor adjustment; do this second

C. Cam chain adjustment — Affects ignition and cam timing which affects individual cylinder performance, and it must be done before carburetor adjustment; do this third

D. Ignition timing — Greatly affects individual cylinder performance, and since the ignition is sometimes driven by the cam chain, it should be done after cam chain adjustment and before carburetor adjustment; do this fourth

E. Air filter service — Must be done before carburetor adjustment because a clogged filter will affect overall engine performance and give improper evaluation of carburetor condition; do this fifth

F. Crankcase ventilation service — This usually means no more than checking the hose from the crankcase to the air box, but some models do have filters and valves that may require cleaning; do this sixth

G. Carburetor adjustment — Assures that the individual carburetors are performing properly; do this seventh

H. Carburetor synchronization — Assures that all carburetors are performing equally and that each cylinder is getting the air-fuel mixture required to do its share of the work; do this eighth

I. Oil and filter change — Should be done while the engine is still warm to assure that all contaminants are suspended in the oil so they will drain out; do this last

(NOTE: If the engine is cold, the contaminants will be settled at the bottom of the crankcase and will only partially drain out.)

INFORMATION SHEET

IV. Spark plug inspection

A. The condition of the spark plugs can provide valuable clues to engine problems, so spark plugs should always be removed and inspected as the first step in engine tune-up.

B. To indicate normal wear, the spark plug insulator will be brown, tan, or, if unleaded fuel is used, gray.

C. Electrode wear will be proportionate to the number of miles of service.

D. Normal coloration and wear in a spark plug indicates that the engine is performing well and that the spark plug is of suitable heat range.

E. If an insulator appears chalk white and blistered, it means the cylinder is overheating.

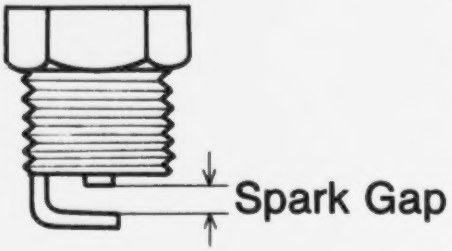
F. Conditions that can cause spark plug overheating are:

1. Advanced ignition timing
2. Clogged carburetor
3. Intake air leaks
4. Wrong spark plug heat range
5. Lean air/fuel mixture

G. If an insulator appears black and oily, it may indicate that the engine air-fuel mixture is too rich or that the rings are bad and letting oil into the combustion chamber.

H. New spark plugs should be inspected for proper gap, and the gap should be reset if it does not meet specifications in the service manual. (Figure 1)

FIGURE 1



INFORMATION SHEET

V. **Valve adjustment**

A. Motorcycle engine valve adjustments are necessary to provide a small amount of clearance between the valve stem and the rocker arm or camshaft.

B. The valve clearance is necessary so that the valve will completely seat on the engine valve seat and compensate for component expansion caused by engine heat.

C. Exhaust valves usually require more clearance than intake valves because they get hotter than intake valves.

D. Rocker arms are mechanical means to open valves, and springs are the mechanical means of closing valves, so rocker arms and springs must be in good condition.

E. Valve clearance adjustments are usually made with an adjusting screw secured by a lock nut or by changing the thickness of a shim between the camshaft and valve stem.

F. Valve shims come in a wide range of thicknesses, and can be easily selected to adjust valves to the clearances required of different engines.

(NOTE: Assignment Sheet #1 gives good examples of shim selection and provides a practical exercise in shim selection.)

G. Always install valve shims with the marking away from the cam shaft so the markings will not be worn off by the camshaft, and technicians servicing the valves at a later date will know what size shim was there.

VI. **Cam chain adjustment**

A. A properly tensioned cam chain will insure that the valves operate in time with piston movement.

B. Excessive play in a cam chain will cause erratic valve timing.

C. Excessive play in a cam chain will cause premature wear to the tensioning device, cam chain guides, rollers, sprockets, and the chain itself.

D. Excessive play can be detected by the slapping sound a chain makes at low engine rpm's.

E. Cam chain tension is usually adjusted automatically by a spring or engine oil pressure.

F. Cam chain tension adjustments vary greatly from model to model, and it's one service area where a technician should always consult the appropriate service manual.

INFORMATION SHEET

VII. Ignition timing

A. Ignition timing is important to engine performance because the spark in the combustion chamber must occur at a precise instant related to engine rpm.

B. As engine rpm increases, the spark must occur at a point in advance of TDC.

C. Igniting the air-fuel mixture sooner allows the fuel to burn completely by the time the piston reaches TDC, and this exerts maximum force on the piston to push it back down the cylinder.

D. If ignition occurs too far in advance of TDC, it causes excessive forces on the piston which can be detected by the sounds of knocking or pinging.

VIII. Ignition timing marks

A. Ignition timing marks are found on the flywheel or on the alternator rotor.

B. Ignition timing marks are always referenced to a fixed mark on the engine case or the timing plug hole.

C. There are three types of ignition timing marks:

1. T means TDC, and when T is lined up with the index mark, the cylinder is at top dead center.
2. F is a timing mark for low engine speed, and it should align with the index mark when the engine is idling.
3. The two other timing marks that are close together indicate the range of advanced timing and the index mark should align with or be in between these two marks when the engine is running at high rpm.

D. Timing advance is controlled automatically by an advancer unit that has to be replaced if it is bad because it cannot be adjusted.

E. Some ignition units can be moved by hand for minor adjustment, but most ignition units are fixed and cannot be adjusted.

IX. Air filter service

A. The purpose of an air filter is to trap dust and dirt that would otherwise get into the engine and cause rapid wear and premature component failures.

B. A clean air supply of sufficient volume is critical to good engine performance.

C. The air filter should always be checked and serviced or replaced on a periodic basis and should always be checked when the engine is tuned up.

INFORMATION SHEET

D. There are two types of motorcycle filters and each demands a specific type of service:

1. Dry-element filters are usually found on street bikes that are ridden mostly on paved surfaces.

2. Dry-element filters are made of paper and wood pulp and can sometimes be blown out and reused.

3. Dry-element filters should never be washed in water or solvent because it will ruin the paper-wood pulp element.

4. Foam rubber or washable gauge filters are usually found on dirt bikes or ATV's that are ridden in dusty or muddy conditions.

5. Foam and washable gauge filters work because they are saturated with special oil that dust particles readily stick to.

6. Foam and washable gauge filters can usually be used again after cleaning.

E. Air filters are usually housed in an "air box" that may be under the seat or in a protected area that will permit unrestricted air flow.

X. Crankcase ventilation

A. Crankcase ventilation is necessary to exhaust gases that blow by the rings during the combustion process, and prevents pressure build-up that could cause crankcase oil leaks.

B. Crankcase ventilation is in the area where the oil is contained, so crankcase ventilation must be designed to exhaust only air and gas, but no oil.

C. Sometimes crankcase ventilation is ducted into the air box so that the escaping gases and fumes will be pulled into the engine and burned.

D. The crankcase ventilation system is so designed that it is usually maintenance free, but sometimes the hose that leads from the crankcase to the air box will come off, wear, out, or get kinked, and in that case, the hose should be replaced.

XI. Carburetor adjustment

A. Carburetor adjustment is seldom necessary because carburetors are preset at the factory, and have anti-tampering devices that must be removed to make adjustments.

B. The adjustments that can be made with the pilot screw generally affect the idle or slow-speed circuit and no other adjustment is usually necessary.

INFORMATION SHEET

C. When fine tuning a carburetor, the idle drop method based on engine rpm can be used, but analyzing exhaust emissions with a meter is also an acceptable procedure.

D. Carburetor adjustments do affect exhaust emission standards, and adjustments should never result in conditions that do not meet EPA standards.

XII. Carburetor synchronization

A. Multi-cylinder engines that use more than one carburetor must sometimes have the carburetors synchronized so that all carburetors are performing on an equal level.

B. Unsynchronized carburetors will cause the engine to run roughly, cause the engine to backfire during deceleration, and generally perform poorly.

C. Carburetors can be synchronized with two different kinds of equipment:

1. The carb stick is probably the most commonly used because it's a relatively inexpensive piece of equipment.
2. The carb stick also provides highly visible results that are easy to compare.
3. Most of all, the carb stick is highly accurate.
4. A vacuum gauge set accomplishes the same thing as a carb stick, but comparing results is sometimes difficult.
5. Both instruments are delicate and must be handled with care because a dropped vacuum gauge would probably have to be replaced, and a dropped carb stick would probably break into pieces.

D. NEVER rev an engine when you're synchronizing carburetors and have a carb stick hooked up because the increase in manifold vacuum would pull the mercury from the carb stick into the engine and exhaust it as poisonous mercury gas.

E. Always use or store a carb stick in a vertical position to prevent mercury from spilling out.

XIII. Oil and filter service

A. Oil should be changed at regular intervals related to mileage and the type of service for which the motorcycle is used.

B. The oil filter should always be changed when the oil is changed.

INFORMATION SHEET

C. Oil selection should be made on the basis of seasonal temperatures and should always be top-quality oil.

D. Oil drain plugs and filter bolts should always be torqued to specifications.

E. The engine should always be warm before starting an oil change, and the most desirable time for an oil change is shortly after a motorcycle has been ridden.

(NOTE: If oil is warm, contaminants will still be suspended and will drain out with the oil, but if the oil is cold, the contaminants will settle to the bottom of crankcase and not drain out with the oil.)

F. Keep motor oil off your hands as much as possible during oil and filter service because most oils contain detergents and hydrocarbons that can be both irritating and damaging to the skin.

BASIC ENGINE TUNE-UP
UNIT XVI

ASSIGNMENT SHEET #1 — SELECT PROPER SHIM THICKNESS FOR SHIM-TYPE VALVE ADJUSTMENT

Directions: Read the background information below and respond to the questions that follow.

Background: Valve shims are usually available in thicknesses ranging from 1.50mm to 3.5mm in increments of .05mm. When replacing a shim, if the exact thickness cannot be found, the shim that is closest to the required thickness will usually be within the service limit.

Example: If the service manual valve clearance limit is from .10 to .20mm, and the present clearance is .26mm, it means the shim has to be increased by a minimum of .06mm.

If the present shim thickness is 2.60mm (and the thickness will be marked on the shim), the best way to correct the problem is to increase the shim thickness two full sizes (remember shims come in thickness increments of .05mm, so increasing two full sizes would give .10mm), and this means selecting a 2.70mm shim.

This would bring the valve clearance to .16mm which would be about mid-point between the .10mm and .20mm clearance limits from the service manual.

Problems: Assume that the valve clearances listed in the service manual are .06mm to .13mm. Check the shim clearance measurements and present shim sizes in the following chart and select the correct shim.

Measured Clearance	Present Shim Size	New Shim Size Needed
1. .10mm	2.60mm	
2. .05mm	2.60mm	
3. .20mm	2.50mm	
4. .11mm	2.65mm	
5. .18mm	2.70mm	

BASIC ENGINE TUNE-UP
UNIT XVI

ANSWERS TO ASSIGNMENT SHEET

1. 2.60mm (present size shim is okay)
2. 2.55mm
3. 2.60mm
4. 2.60mm (present shim size is okay)
5. 2.80mm

BASIC ENGINE TUNE-UP
UNIT XVI

JOB SHEET #1 — PERFORM A COMPRESSION TEST ON A MOTORCYCLE ENGINE

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Compression gauge set
6. Pencil
7. Safety glasses

B. Routine #1 — Checking dry compression

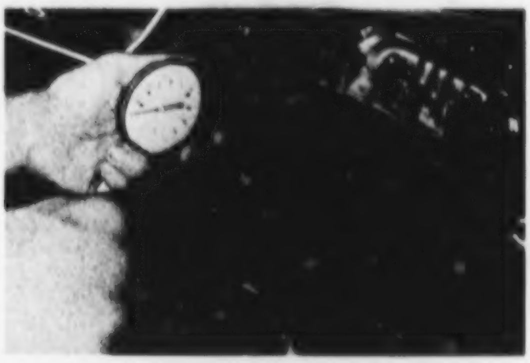
1. Put safety glasses on.
2. Secure the bike in an upright position.
3. Start the engine and warm it to normal operating temperature.
4. Remove the spark plug(s).
5. Select the proper adapter and screw it into the spark plug hole. (Figure 1)

FIGURE 1

JOB SHEET #1

6. Clip the compression tester to the adapter. (Figure 2)

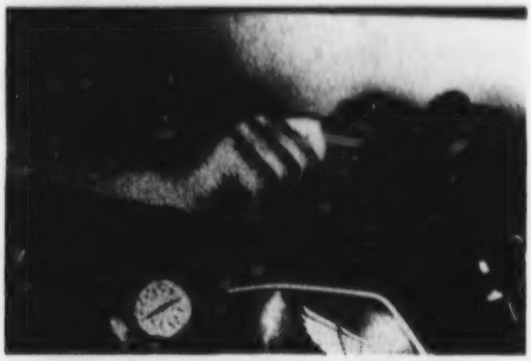
FIGURE 2



7. Hold the compression gauge so you can read it.

8. Turn the throttle on the motorcycle to a wide open position. (Figure 3)

FIGURE 3



9. Engage the starter until the engine has made several revolutions or until the needle on the gauge stops moving. (Figure 4)

FIGURE 4

JOB SHEET #1

10. Read and record your results here: ______________

    a. If compression is low, it could be a problem with the head gasket, the valves, or the pistons and rings.

       (NOTE: Top end repairs will be covered in a later unit, but for now, continue your troubleshooting.)

    b. If compression appears to be okay, the problem is somewhere else.

    c. If compression is low, a wet test will help you further isolate the problem.

☐ Have your instructor check your work.

C. Routine #2 — Making a wet compression test

1. Leave your safety glasses on.
2. Remove the compression gauge adapter from the spark plug hole.
3. Squirt a small amount of engine oil into the spark plug hole. (Figure 5)

FIGURE 5

4. Replace the adapter in the spark plug hole.
5. Repeat the compression checking procedure outlined in Routine #1.

    a. If compression increase is noticeable, the problem is mostly likely with the piston and rings.

       (NOTE: Piston and ring service will be covered in another unit.)

    b. If there is little or no increase in compression, the problem is mostly likely in the valves or possibly the head gasket.

☐ Have your instructor check your work.

6. Clean up area and return tools and equipment to proper storage.

BASIC ENGINE TUNE-UP
UNIT XVI

JOB SHEET #2 — PERFORM A LEAK-DOWN TEST ON A MOTORCYCLE ENGINE

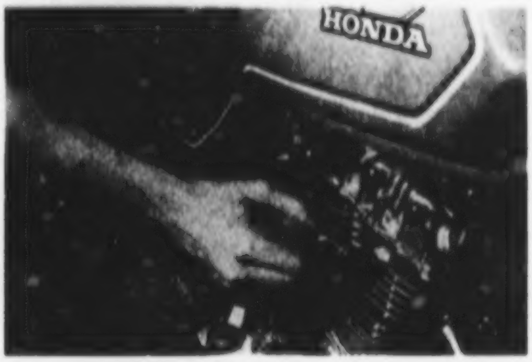
A. Tools and materials

1. Motorcycle or engine as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towel
5. Cylinder leak-down tester
6. Pencil
7. Minimum 60-lb. compressed air supply
8. Safety glasses

B. Procedure

1. Check to make sure the area is free of fire hazards and that there is a fire extinguisher nearby.
2. Put on safety glasses.
3. Remove the spark plug. (Figure 1)

FIGURE 1



JOB SHEET #2

4. Put the engine at TDC on the compression stroke.

   (NOTE: On a four-stroke engine, make certain it is not on TDC between the exhaust and intake stroke, so if you have doubts, ask your instructor for help.)

5. Lock the crankshaft in place so that it cannot turn during this test. (Figure 2)

   (CAUTION: Have your instructor check to make sure the crankshaft is secure because if it turns when compressed air is applied to the engine it will invalidate the test and perhaps injure you or somebody else.)

FIGURE 2

6. Install the adapter into the spark plug hole. (Figure 3)

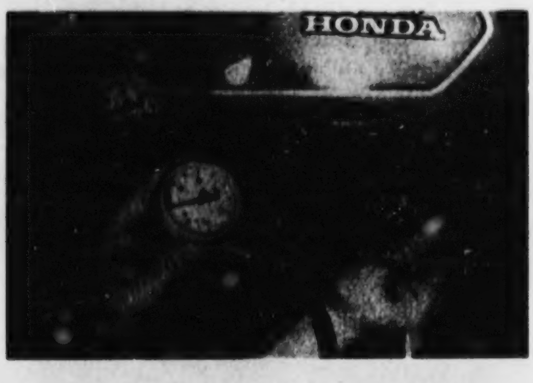
FIGURE 3

JOB SHEET #2

7. Hook the leakage tester to the adapter. (Figure 4)

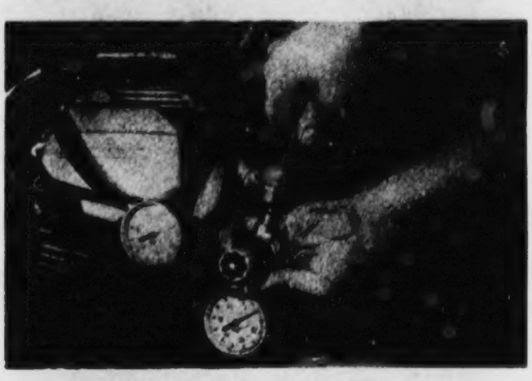
(CAUTION: If you're using a manually adjustable tester, make certain that the regulator control is backed out all the way so there will be no immediate surge of pressure in the cylinder when you turn the compressed air on.)

FIGURE 4



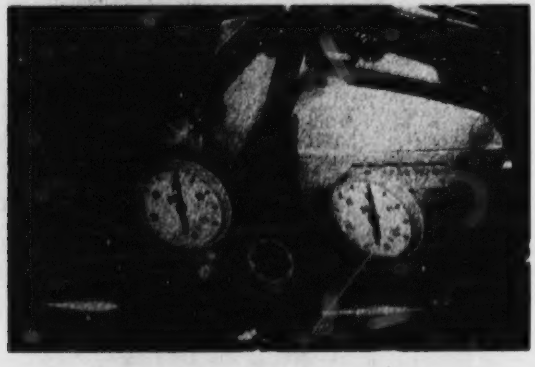
8. Hook the compressed air line onto the tester. (Figure 5)

FIGURE 5



9. Turn the regulator knob in slowly to permit compressed air to enter the cylinder, and do not open the regulator beyond 60 PSI. (Figure 6)

FIGURE 6



JOB SHEET #2

10. Use the troubleshooting log that accompanies this job sheet to record the pressure readings on both gauges.

    a. If both gauges read the same, it means there is zero leakage and there is no problem with compression.

    b. If the second gauge reads less than 60 PSI, divide that figure into 60, and then subtract that figure from 100 to get your percentage of leakage.

    Example: If the second gauge reads 40 PSI, 40 divided by 60 equals approximately 66, and 66 from 100 leaves 33, so the leakage is 33 percent

11. Consult your service manual for the maximum allowable leakage, and record that figure here: ____________

    a. If you get an unallowable percentage of leakage, you can isolate the problem by listening for and feeling the source of the escaping air.

    (NOTE: This sometimes requires removing the exhaust pipe, the carburetor, the dipstick, or the oil filter plug.)

    b. If the percentage of leakage is within allowable limits, then compression is okay.

☐ Have your instructor check your work before removing any test equipment.

12. Clean up area and return tools and materials to proper storage.

BASIC ENGINE TUNE-UP
UNIT XVI

JOB SHEET #3 — ADJUST THE VALVES ON A MOTORCYCLE ENGINE

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towel
5. Feeler gauge sets (two required)
6. Shims as required
7. Pencil
8. Safety glasses

B. Routine #1 — Making a lock nut and adjuster screw valve adjustment

1. Put on safety glasses.
2. Remove the gas tank only if necessary and set it in a safe place.
3. Remove the flywheel cover or timing mark inspection plug so you will be able to turn the crankshaft.
4. Remove the valve adjusting caps or covers.

JOB SHEET #3

5. Turn the crankshaft manually and watch the intake valve rocker arm until it opens, then closes the intake valve. (Figure 1)

FIGURE 1

6. Watch for the T mark on the flywheel to align with the static timing mark on the crankcase, and leave the crankshaft in that position. (Figure 2)

   (NOTE: The T means that the piston is at top dead center on the compression stroke, both intake and exhaust valves are closed, and it is the only position in which valve clearance can be accurately measured.)

FIGURE 2

7. Check the service manual for the recommended valve clearances, and write both the intake and exhaust clearances on the valve service log that accompanies this job sheet.

JOB SHEET #3

8. Measure the intake and exhaust valve clearance by inserting the feeler gauge between the adjusting screw and valve stem. (Figure 3)

FIGURE 3

9. Keep measuring until you find the blade thickness that will fit into the clearance and can be worked in and out with only a slight drag.

10. Record your measurements on the service log.

11. Adjust the valves with the following procedure:

    a. Loosen the lock nut and turn the adjusting screw clockwise to decrease the valve clearance or counterclockwise to increase the valve clearance. (Figure 4)

    FIGURE 4

    b. Insert the appropriate size feeler gauge blade into the gap between the valve stem and the valve adjusting screw and turn the adjusting screw clockwise or counterclockwise until there is a slight drag on the feeler gauge blade when you move it in and out.

JOB SHEET #3

c. If you are working with a three or four-valve cylinder head that uses a forked or single rocker arm that pushes both valves open, both valves have to be adjusted at the same time, and this requires two feeler gauges. (Figure 5)

FIGURE 5

d. While holding the adjusting screw in position, tighten the lock nut down.

e. Recheck the adjustment with the appropriate feeler gauge blade.

12. Repeat the procedure on the other valve, and be sure to record all measurements on your service log.

(NOTE: Some technicians prefer to tighten the adjustment screw just a little extra before tightening the lock nut because when the lock nut is tightened, it will pull slack out of the adjusting screw and provide an additional amount of clearance that compensates for the slack itself and gives a precise adjustment.)

13. Recheck both valve clearances.

☐ Have your instructor check your work.

14. Replace the adjusting caps or covers, the flywheel cover or timing mark inspection plug, and replace the gas tank if you removed it.

C. Routine #2 — Adjusting shim-type valves

1. Leave your safety glasses on.

2. Remove the gas tank only if necessary and set it in a safe place.

3. Remove the flywheel cover or timing mark inspection plug so you will be able to turn the crankshaft.

4. Remove the valve adjusting caps or covers.

JOB SHEET #3

5. Rotate the crankshaft until the intake valves open and then close.

6. Continue rotating the crankshaft until the T mark (the top dead center mark) is aligned with the static timing mark on the crankcase.

7. Leave the crankcase in that position

   (NOTE: The T means that the piston is at top dead center on the compression stroke, both intake and exhaust valves are closed, and it is the only positon in which valve clearance can be accurately measured.)

8. Check the service manual for the recommended valve clearances, and write both the intake and exhaust clearances on the valve service log that accompanies this job sheet.

9. Measure the intake and exhaust valve clearance by inserting the feeler gauge between the valve lifter shim and the camshaft. (Figure 6)

FIGURE 6

10. Keep measuring until you find the blade thickness that will fit into the clearance and can be worked back and forth with only a slight drag.

11. Record your measurements on the service log, and if it's a multi-cylinder engine, make all measurements as outlined and record all measurements.

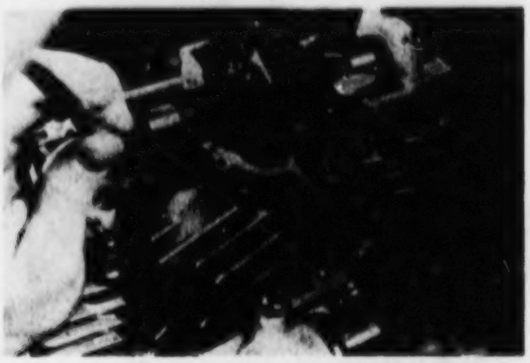
12. Compare your measurements with the valve clearance limits from the service manual to determine the shim sizes you will need to adjust valve clearances.

JOB SHEET #3

13. Remove and replace shims until all corrections are made. (Figure 7)

    (NOTE: It's best to check the service manual for this procedure.)

    FIGURE 7



14. Check all valve clearances after shim installation to make sure they all conform to specifications.

☐ Have your instructor check your work.

15. Replace the valve adjusting caps or covers, replace the timing mark inspection plug or flywheel cover, and replace the gas tank if you removed it.

16. Clean up area and return tools and materials to proper storage.

JOB SHEET #3

Valve Service Log

Lock nut and adjuster screw valves:	Service Manual Clearance	Your Measurement
Intake 1:		
Intake 2:		
Exhaust 1:		
Exhaust 2:		

Shim-type valves:		Service Manual Clearance	Your Measurement	Present Shim Size	Shim Size Needed
Cylinder 1	1:				
	2:				
	3:				
	4:				
Cylinder 2	1:				
	2:				
	3:				
	4:				
Cylinder 3	1:				
	2:				
	3:				
	4:				
Cylinder 4	1:				
	2:				
	3:				
	4:				
Cylinder 5	1:				
	2:				
	3:				
	4:				
Cylinder 6	1:				
	2:				
	3:				
	4:				

Your name ______________________________ Date ____________

BASIC ENGINE TUNE-UP
UNIT XVI

JOB SHEET #4 — ADJUST CAM CHAIN TENSION

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Secure the bike in an upright position.
3. Check the service manual for the cam chain adjustment procedure.

   (NOTE: Cam chain adjustment procedures vary significantly from model to model, and there is no common procedure that would come close to serving general cam chain adjustments.)

4. Check your adjustment by listening carefully while the bike is idling for a rattling or a slapping sound which will indicate adjustment is required.
5. Repeat adjustment procedures as required, and check again.

   (NOTE: If the cam chain will not adjust, it almost always means the chain is worn out and should be replaced.)

☐ Have your instructor check your work.

6. Clean up area and return tools and materials to proper storage.

BASIC ENGINE TUNE-UP
UNIT XVI

JOB SHEET #5 — INSPECT IGNITION TIMING

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Timing light
6. Piece of white chalk
7. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Secure the bike in an upright position.
3. Remove the timing hole cap or covers to expose the timing marks on the flywheel or alternator rotor.
4. Check the service manual and determine which timing mark you should be referencing.
5. Locate the mark on the flywheel or alternator rotor and mark it with a piece of white chalk so it will be highly visible.
6. Connect the timing light to the #1 spark plug lead and the battery of the motorcycle.
7. Start the engine.
8. Check the timing with the procedure outlined in the service manual.

   (NOTE: Some timing checks are made with the engine idling, and other timing checks require that the engine be operating at 5,000 rpm.)

JOB SHEET #5

9. Adjust timing with the following procedure if you are working on an ignition that can be adjusted:

    a. Loosen the backing plate screws.

    b. If the rotor turns in a counterclockwise rotation, turn the ignition unit clockwise to advance timing and counterclockwise to retard timing.

    c. If the rotor turns in a clockwise rotation, turn the ignition unit counterclockwise to advance timing and clockwise to retard timing.

    d. Retighten the locking plate screws.

10. Check timing again to make sure it agrees with specifications.

☐ Have your instructor check your work.

11. Shut off the engine and disconnect the timing light.

12. Replace the timing hole cap or cover.

13. Clean up area and return tools and materials to proper storage.

BASIC ENGINE TUNE-UP
UNIT XVI

JOB SHEET #6 — SERVICE AN AIR FILTER

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Compressed air supply
6. Cleaning solvent
7. Hot, soapy water
8. Air filter oil
9. Safety glasses

B. Routine #1 — Servicing a dry air filter element

1. Put on safety glasses.
2. Take the seat off, if required, and then remove the air filter cover. (Figure 1) . .

FIGURE 1

3. Remove the air filter.

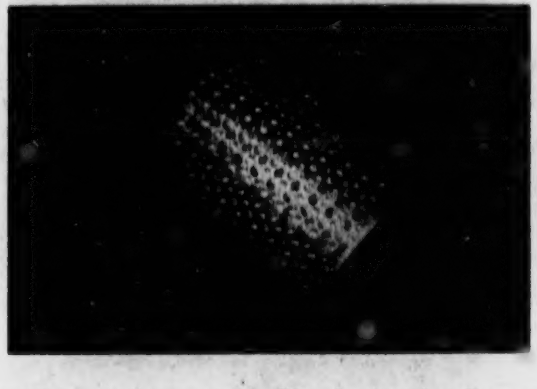
JOB SHEET #6

4. Inspect the sealing surface of the air filter for damage or deterioration, and if the sealing surface is torn or loose, replace the filter. (Figure 2)

FIGURE 2

5. Inspect the filter body for damage, holes, or deterioration at any point, and if the filter appears old, or worn, or damaged, replace it. (Figure 3)

FIGURE 3



6. Knock the loose dirt out of a reusable filter by tapping it on a workbench sideways.

   (NOTE: If a lot of dirt comes out of the filter at this point, it is probably clogged and should be replaced.)

7. So, if the filter appears to be swelled or blistered: it is an indication that the filter has been wet and it should be replaced; wetting a filter causes the wood-pulp in the filter to swell and restrict air flow.

☐ Have your instructor check your work.

8. Replace the filter into the filter box and make sure it seals properly.

9. Replace the air filter cover, and the seat, if you removed it.

JOB SHEET #6

C. Routine #2 — Servicing a foam or washable gauge air filter

1. Leave your safety glasses on.

2. Take the seat off, if required, and then remove the air filter cover and air filter.

3. Disassemble the air filter with the following procedure:

   a. If it is a foam-type filter, take off the metal-screen frame that covers the filter. (Figure 4)

      FIGURE 4

   b. If it is a one-piece washable gauge filter, disassembly is not required.

4. Inspect the sealing surface on a one-piece gauge filter for damage or deterioration.

5. Inspect a foam filter to make sure it hasn't separated along the seam.

6. Wash either type filter in clean solvent.

   a. If it is a foam filter, dip it in the solvent a few times and squeeze it dry, but don't wring it dry or you'll damage the foam.

JOB SHEET #6

b. If it is a one-piece filter dip it in the solvent several times, swishing it around as you do, and shake the solvent off. (Figure 5)

FIGURE 5

7. Wash either type filter in hot soapy water to remove all solvent and remaining contaminants. (Figure 6)

FIGURE 6

8. Rinse the filter in clean water until it is free of soap.

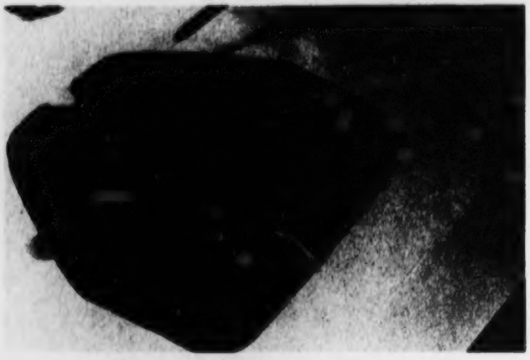
9. Allow the filter to dry.

☐ Have your instructor check your work.

JOB SHEET #6

10. Oil a foam filter with special filter oil by working the oil well into it, wrapping the filter in a clean shop towel, and then gently squeezing out any excess oil. (Figure 7)

FIGURE 7



11. Dip a one-piece filter in oil about one-third of the way and then turn it over and allow oil to flow over the rest of the filter. (Figure 8)

FIGURE 8

12. Allow a one-piece filter to set for at least two hours after oiling so all excess oil will drain off.

13. Install a foam filter back onto its metal-mesh frame until it is seated properly over the frame.

14. Install the filter, making sure it seals properly.

☐ Have your instructor check your work.

15. Replace the air filter cover, and replace the seat if you removed it.

16. Clean up area and return tools and materials to proper storage.

BASIC ENGINE TUNE-UP
UNIT XVI

JOB SHEET #7 — ADJUST A MOTORCYCLE CARBURETOR USING AN EXHAUST GAS ANALYZER

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Exhaust gas analyzer
6. Cooling fan
7. Pencil
8. Auxiliary gas supply
9. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Turn the exhaust gas analyzer on and let it warm up for half an hour. (Figure 1)

FIGURE 1

3. Check area to make sure it is free of combustibles and that there is a fire extinguisher nearby.

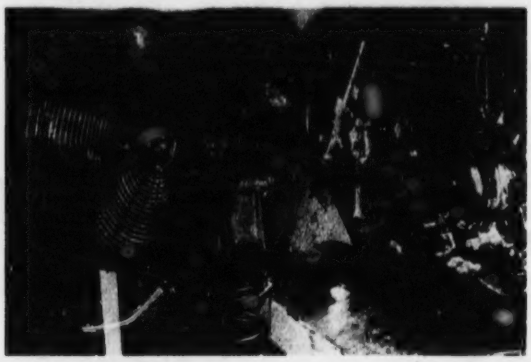
JOB SHEET #7

4. Secure the bike in an upright position.

5. Remove the gas tank and connect carburetor to auxiliary fuel supply, if needed.

6. Place the fan so it will blow over the motor, and turn the fan on. (Figure 2)

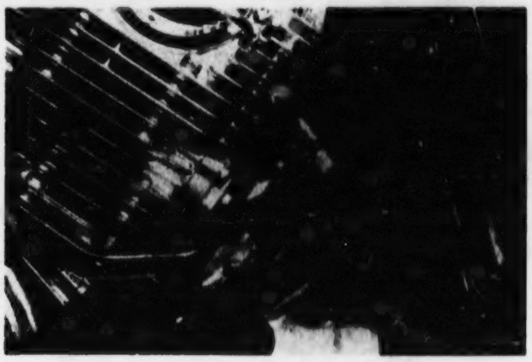
FIGURE 2



7. Remove the limiter caps or pilot screw access plugs from the carburetors, as previously outlined.

8. Remove the gas analyzer access plug from each exhaust pipe. (Figure 3)

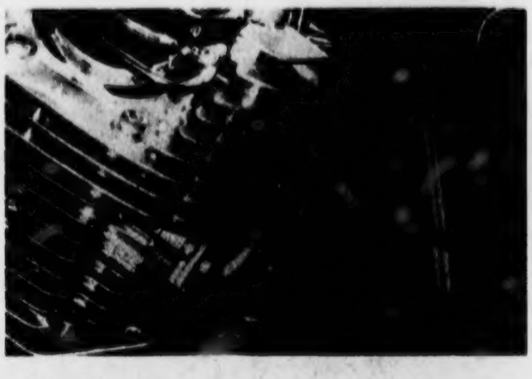
FIGURE 3



JOB SHEET #7

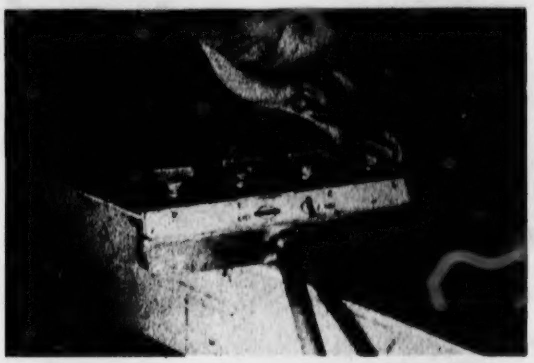
9. Attach the exhaust gas analyzer adapter to each exhaust pipe access. (Figure 4)

FIGURE 4



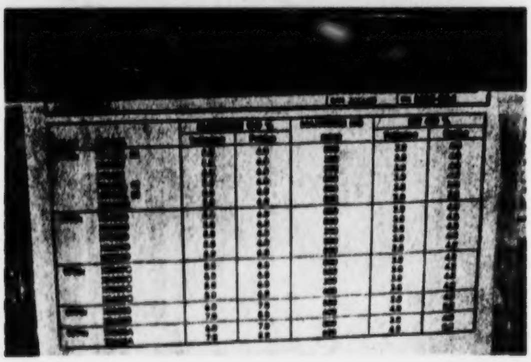
10. Make certain you have the analyzer set so that you can analyze only one cylinder at a time. (Figure 5)

FIGURE 5



11. Check the service manual for the exhaust gas emission specifications and write them down for reference: ______________ (Figure 6)

FIGURE 6

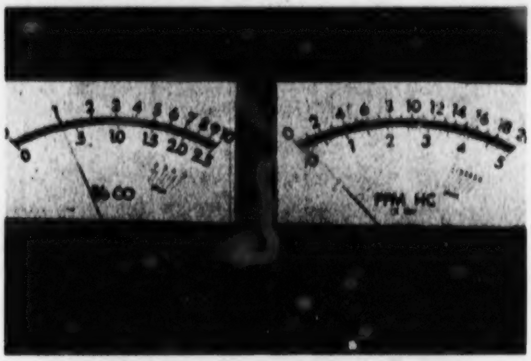


JOB SHEET #7

12. Start the engine and allow it to warm up to normal operating temperature.

13. Check each cylinder and adjust the carburetor pilot screw to bring that cylinder within specifications. (Figure 7)

FIGURE 7



14. Analyze the remaining cylinders and make carburetor adjustments as needed.

☐ Have your instructor check your work.

15. Shut the engine off and give the exhaust system a little time to cool down before you replace the analyzer access plugs.

16. Replace the limiter caps or pilot screw access plugs.

(CAUTION: In the following step, it is easy to spill gasoline, so work with care.)

17. Disconnect the auxiliary gas supply and reinstall the gas tank.

18. Clean up area and return tools and materials to proper storage.

BASIC ENGINE TUNE-UP
UNIT XVI

JOB SHEET #8 — SYNCHRONIZE CARBURETORS ON A MULTI-CYLINDER MOTORCYCLE ENGINE

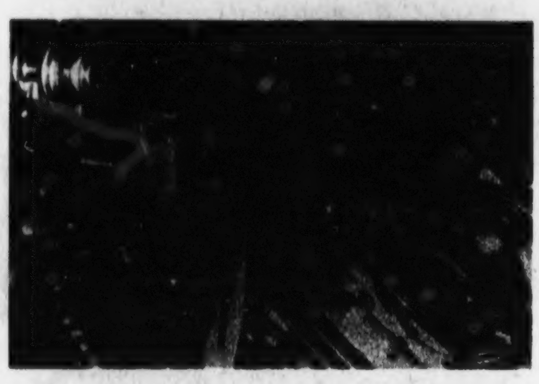
A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Carb synchronizing stick or vacuum gauge set
6. Appropriate carburetor adjusting tool
7. Gas caddy or auxiliary fuel supply
8. Cooling fan
9. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Remove the gas tank and set it aside in a safe place.
3. Remove the adapter screws or rubber plugs on the intake manifold. (Figure 1)

FIGURE 1



JOB SHEET #8

4. Screw the carb stick adapters into the intake manifold where the adapter screws or rubber plugs were removed, if required.

   (NOTE: This job sheet assumes that you are working with a carburetor synchronizing stick, but working with vacuum gauges is a similar procedure.)

5. Attach the carb stick hoses to the adapters in the proper sequence so you'll know which hose is measuring which carburetor. (Figure 2)

FIGURE 2

6. Check the area to make sure it's free of combustibles and that there is a fire extinguisher nearby.

7. Hook up the auxiliary fuel supply to the carburetors, if needed.

   (NOTE: Be sure to use a T if you're hooking into two inlet lines, and be sure you have shut-off controls for each line.)

8. Start the motorcycle engine and allow it to idle only, but do not rev it up.

   (CAUTION: If you rev the engine, enough vacuum will be formed in the carb stick lines to literally pull the mercury out of the manometer into the engine and create dangerous toxic fumes.)

9. Place the fan in front of the motorcycle so it will direct air over the engine to keep it from overheating. (Figure 3)

FIGURE 3

JOB SHEET #8

10. Determine which carburetor is the master carburetor.

    (NOTE: The master carburetor is the one with the throttle cable attached to it and it will have no adjusting screws except for maybe an idle speed adjusting screw.)

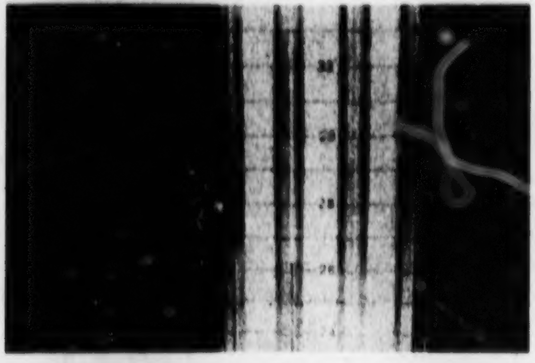
11. Allow the engine to reach normal operating temperature, and then set the idle speed at 1,000 rpm.

12. Identify the column of mercury that gives the reading for the master carburetor and begin comparing the height of the other columns of mercury with it.

13. Synchronize each carburetor to the master carburetor according to the following evaluation:

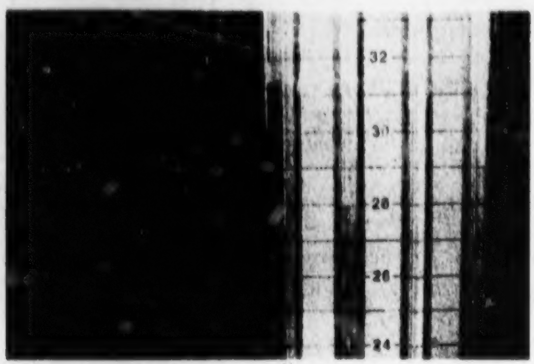
    a. If the column of mercury is higher than the mercury for the master carburetor, it means that the manifold vacuum is higher and the carburetor is set too low or not getting enough air. (Figure 4)

FIGURE 4



    b. If the column of mercury is lower than the mercury for the master carburetor, it means that the manifold vacuum is lower and the carburetor is set too high or getting too much air. (Figure 5)

FIGURE 5



JOB SHEET #8

14. Adjust the inside carburetor first and work to the outside carburetor.

15. Use your carburetor adjusting tool as outlined in the service manual to decrease or increase throttle openings in the individual carburetors. (Figure 6)

FIGURE 6

16. Work with the lock nut and screw or with the spring loaded screw until the adjustment is completed on all carburetors.

17. Adjust idle speed as required during synchronization to maintain 1,000 rpm.

18. Continue making carburetor adjustments until all columns of mercury are within 6mm of the master carb and the engine idle speed is at 1,000 rpm.

19. Stop the engine.

20. Work the throttle to wide open a couple of times, and then let the throttle return to the idle position.

21. Restart the engine.

22. Check the columns of mercury again to make sure there has not been a dramatic change in height, and if any height change has been significant, repeat the synchronization procedure.

☐ Have your instructor check your work.

23. Remove the carburetor adjusting equipment, replace the manifold adjustment screws or plugs, and replace the gas tank.

24. Clean up area and return tools and materials to proper storage.

BASIC ENGINE TUNE-UP
UNIT XVI

JOB SHEET #9 — CHANGE ENGINE OIL AND FILTER

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Filter wrench
6. Grease
7. Oil drain pan
8. Oil and replacement filter
9. Funnel
10. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Secure the bike in an upright position.

   (CAUTION: If you spill oil at any point in this procedure, clean it up immediately to avoid creating a safety hazard, and avoid getting oil on your hands.)

3. Start engine and allow bike to warm up to normal operating temperature.

   (CAUTION: Work with care around a hot engine and exhaust system or you will burn yourself, but remember, for contaminants to remain suspended so they will drain with the oil, the oil has to be hot.)

JOB SHEET #9

4. Set the oil drain pan in place and remove the oil drain plug and let the oil start draining. (Figure 1)

   (NOTE: There are often other plugs that look like oil drain plugs underneath the engine, so consult the service manual to make sure you have the oil drain plug and not the gearshift stopper spring plug or the middle gear box oil drain plug.)

   FIGURE 1

5. Remove the oil filter while the engine oil is draining, making sure that the oil drain pan reaches underneath the oil that spills from the filter. (Figure 2)

   FIGURE 2

6. Install a spin-on type filter with the following procedure:

   a. Clean the sealing surface on the engine with a clean shop towel.

   b. Lightly lubricate the sealing surface on the new filter with oil.

   c. Screw the filter on until the sealing gasket makes contact.

   d. Tighten the filter an additional one-half to three-fourths turn by hand, but do not use a filter wrench to tighten a filter or you will never get the filter off.

JOB SHEET #9

7. Install a cannister-type filter with the following procedure:

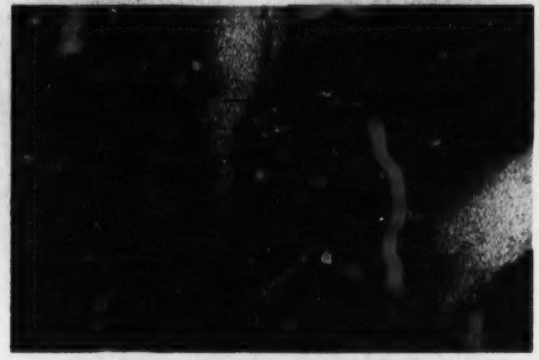
   a. Wash the cannister housing with solvent and dry it with compressed air.

   b. Clean the sealing surface on the engine with a clean shop towel. (Figure 3)

FIGURE 3

   c. Install a new O-ring on the filter bolt. (Figure 4)

FIGURE 4



JOB SHEET #9

d. Slide the filter bolt into the housing far enough to install the spring and the washer onto the bolt. (Figure 5)

FIGURE 5

e. Install the new filter onto the bolt, taking care that you do not force it in such a way that you dislodge the O-ring that is on each end of the filter. (Figure 6)

FIGURE 6

f. Install the seating O-ring onto the filter cannister.

g. Place the entire assembly onto the engine so that the tang and pin that position the filter housing are properly aligned. (Figure 7)

FIGURE 7

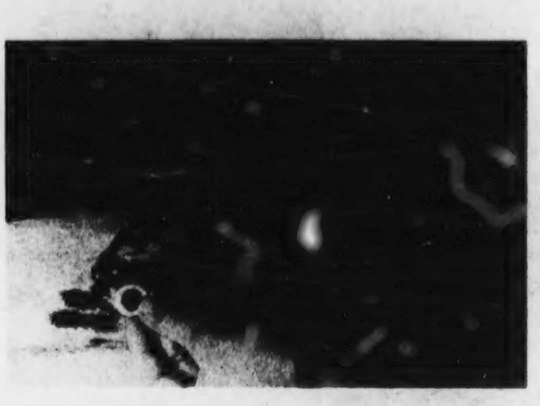
JOB SHEET #9

h. Tighten the oil filter bolt to the torque specified in the service manual.

8. Check to make sure that all oil has drained from the engine.

9. Inspect the sealing washer on the drain plug, and replace it if it is damaged. (Figure 8)

FIGURE 8



10. Install the drain plug and torque it to specifications in the service manual.

11. Remove the oil drain pan and dispose of the old oil in the proper manner.

12. Refill the engine crankcase with the quality and quantity of oil specified in the service manual.

13. Replace the oil filler plug.

14. Start the engine.

    (CAUTION: Do not rev the engine at this point because oil pressure has not yet built up and you could damage the engine.)

15. Make certain the oil pressure alert light goes out.

16. Inspect the area around the oil filter and the drain plug for leaks.

    (NOTE: If you find a leak, overtightening will not solve the problem, chances are an O-ring or sealing gasket did not seat properly, and you'll have to re-drain the crankcase and investigate the problem.)

17. Shut the engine off, let the bike sit for about a minute, and then check the oil level with the sight gauge or with a dip stick.

☐ Have your instructor check your work.

18. Clean up area and return tools and materials to proper storage.

BASIC ENGINE TUNE-UP
UNIT XVI

PRACTICAL TEST #1
JOB SHEET #1 — PERFORM A COMPRESSION TEST ON A MOTORCYCLE ENGINE

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

> **Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.**

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Secured bike and warmed up engine.	2.	☐	☐
3. Removed spark plug and used correct adapter.	3.	☐	☐
4. Checked dry compression.	4.	☐	☐
5. Recorded results.	5.	☐	☐
6. Removed adapter and squirted oil into spark plug hole.	6.	☐	☐
7. Replaced adapter and checked wet compression.	7.	☐	☐
8. Recorded results.	8.	☐	☐
9. Cleaned up area and returned tools to storage.	9.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC ENGINE TUNE-UP
UNIT XVI

PRACTICAL TEST #2
JOB SHEET #2 — PERFORM A LEAK-DOWN TEST ON A MOTORCYCLE ENGINE

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Set engine at TDC on the compression stroke.	2.	☐	☐
3. Hooked compressed air line to tester.	3.	☐	☐
4. Completed leak-down test properly.	4.	☐	☐
5. Recorded results.	5.	☐	☐
6. Cleaned area and returned tools to storage.	6.	☐	☐

Evaluator's comments: ____

____

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JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC ENGINE TUNE-UP
UNIT XVI

PRACTICAL TEST #3
JOB SHEET #3 — ADJUST THE VALVES ON A MOTORCYCLE ENGINE

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Prepared engine for valve adjustment.	2.	☐	☐
3. Aligned flywheel T mark with crankcase timing mark.	3.	☐	☐
4. Checked valve clearance in service manual.	4.	☐	☐
5. Measured valve clearances with feeler gauge.	5.	☐	☐
6. Adjusted valve properly.	6.	☐	☐
7. Adjusted shim-type valves properly.	7.	☐	☐
8. Recorded log entries appropriately.	8.	☐	☐
9. Cleaned area and returned tools to storage.	9.	☐	☐

Evaluator's comments: ____

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JOB SHEET #3 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC ENGINE TUNE-UP
UNIT XVI

PRACTICAL TEST #4
JOB SHEET #4 — ADJUST CAM CHAIN TENSION

Student's name ______________________________ Date ____________

Evaluator's name ______________________________ Attempt no. ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Secured bike in upright position.	2.	☐	☐
3. Checked service manual for adjustment procedure.	3.	☐	☐
4. Made adjustment to specifications.	4.	☐	☐
5. Started and idled bike to check adjustment.	5.	☐	☐
6. Cleaned area and returned tools to storage.	6.	☐	☐

Evaluator's comments: ____

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JOB SHEET #4 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

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BASIC ENGINE TUNE-UP
UNIT XVI

PRACTICAL TEST #5
JOB SHEET #5 — INSPECT IGNITION TIMING

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

> **Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.**

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Located and marked proper timing mark on flywheel.	2.	☐	☐
3. Connected timing light properly.	3.	☐	☐
4. Checked timing per specifications.	4.	☐	☐
5. Adjusted timing with proper procedure.	5.	☐	☐
6. Replaced components removed for adjustment.	6.	☐	☐
7. Cleaned area and returned tools to storage.	7.	☐	☐

Evaluator's comments: ____

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JOB SHEET #5 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC ENGINE TUNE-UP
UNIT XVI

PRACTICAL TEST #6
JOB SHEET #6 — SERVICE AN AIR FILTER

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed dry filter.	2.	☐	☐
3. Inspected filter and sealing surfaces.	3.	☐	☐
4. Serviced dry filter properly.	4.	☐	☐
5. Serviced a foam-type filter properly.	5.	☐	☐
6. Replaced filters as required.	6.	☐	☐
7. Cleaned area and returned tools to storage.	7.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #6 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC ENGINE TUNE-UP
UNIT XVI

PRACTICAL TEST #7
JOB SHEET #7 — ADJUST A MOTORCYCLE CARBURETOR USING AN EXHAUST GAS ANALYZER

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Placed fan to blow over motor.	2.	☐	☐
3. Removed gas analyzer plugs from exhaust.	3.	☐	☐
4. Checked service manual for emission standards.	4.	☐	☐
5. Checked each cylinder properly.	5.	☐	☐
6. Made adjustments to specifications.	6.	☐	☐
7. Replaced plugs and limiter caps.	7.	☐	☐
8. Cleaned area and returned tools to storage.	8.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #7 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC ENGINE TUNE-UP
UNIT XVI

PRACTICAL TEST #8
JOB SHEET #8 — SYNCHRONIZE CARBURETORS ON A MULTI-CYLINDER MOTORCYCLE ENGINE

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Removed adapter screws and attached carb stick.	2.	☐	☐
3. Placed fan properly to cool engine.	3.	☐	☐
4. Started engine and adjusted idle speed to 1,000 rpm.	4.	☐	☐
5. Started with master carburetor and synchronized all carburetors.	5.	☐	☐
6. Stopped engine.	6.	☐	☐
7. Worked throttle and restarted engine.	7.	☐	☐
8. Verified synchronization.	8.	☐	☐
9. Cleaned area and returned tools to storage.	9.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #8 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY
4 — Skilled 3 — Moderate skills 2 — Limited skills 1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC ENGINE TUNE-UP
UNIT XVI

PRACTICAL TEST #9
JOB SHEET #9 — CHANGE ENGINE OIL AND FILTER

Student's name ________________________ **Date** ____________

Evaluator's name ________________________ **Attempt no.** ______

> **Student Instructions:** When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Started engine, warmed engine to normal operating temperature.	2.	☐	☐
3. Drained oil with proper care.	3.	☐	☐
4. Removed filter while oil was draining.	4.	☐	☐
5. Installed filter properly.	5.	☐	☐
6. Installed drain plug and torqued to specifications.	6.	☐	☐
7. Refilled crankcase with proper oil of right quantity.	7.	☐	☐
8. Replaced filler plug.	8.	☐	☐
9. Inspected filter and plug for leaks.	9.	☐	☐
10. Cleaned area and returned tools to storage.	10.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #9 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC ENGINE TUNE-UP
UNIT XVI

NAME ______________________

TEST

1. Match terms related to basic engine tune-up with their correct definitions.

_____a. The combustion pressure that is forced past piston rings and down into the crankcase

_____b. A poisonous gas produced by the incomplete burning of substances containing carbon

_____c. A closely-spaced series of four or six glass columns about three feet long with the lower ends submerged in a reservoir of mercury and a hose attached to the other end so it can be attached to a manifold to measure vacuum

_____d. Standards set by the environmental protection agency to limit the amount of hydrocarbons and carbon monoxide that are exhausted by an engine

_____e. The amount of unburned gasoline or oil vapor exhausted by a running engine

_____f. Engine pings or knocks produced by excessive heat, excessive compression, or gasoline with too low an octane

_____g. Ignition timing that is advanced to a degree that causes pinging or clattering and can result in engine failure

_____h. A frame-mounted set of gauges designed to show manifold vacuum on individual cylinders

1. EPA standards
2. Vacuum gauge set
3. Detonation
4. Carbon monoxide
5. Blow-by
6. Hydrocarbon
7. Pre-ignition
8. Carb stick

TEST

2. Complete statements concerning engine tune-up preparations by inserting the word(s) that best completes each statement.

    a. Many motorcycle owners don't understand the mechanics of engine operation and frequently take a bike in for a tune-up when the real problem is ____________ ____________ or ____________.

    b. There are some conditions which usually indicate that an engine may need more than a tune-up:

        1) An ____________ exhaust pipe or ____________ ____________ out the exhaust pipe

        2) An air filter that is ____________ with engine oil

        3) Excessive ____________ noise

        4) ____________ ____________ that are fouled with oil or burned excessively

        5) An engine that uses an excessive amount of ____________

        6) An engine that is missing on one or more ____________

    c. When an engine is suspected of having severe wear or damage, it is recommended that the engine be ____________ ____________ ____________ or that a ____________ ____________ ____________ be performed to verify problems.

3. Complete statements concerning engine tune-up sequence by inserting the word(s) that best completes each statement.

    a. Spark plug inspection and replacement — New plugs are almost always required and the old plugs provide clues to indicate the ____________ of the engine; do this first

    b. Valve adjustment — Must be made while the engine is ____________, and since it affects individual cylinder performance, it must be done before carburetor adjustment; do this second

    c. Cam chain adjustment — Affects ignition and cam timing which affects individual cylinder performance, and it must be done before ____________ ____________; do this third

    d. Ignition timing — Greatly affects individual cylinder performance, and since the ignition is sometimes driven by the cam chain, it should be done after ____________ ____________ ____________ and before ____________ ____________; do this fourth

TEST

e. Air filter service — Must be done before ____________ ____________ because a clogged filter will affect overall engine performance and give improper evaluation of carburetor condition; do this fifth

f. Crankcase ventilation service — This usually means no more than checking the hose from the crankcase to the air box, but some models do have ____________ and ____________ that may require cleaning; do this sixth

g. Carburetor adjustment — Assures that the individual ____________ are performing properly; do this seventh

h. Carburetor synchronization — Assures that all carburetors are performing equally and that each cylinder is getting the ____________ ____________ required to do its share of the work; do this eighth

i. Oil and filter change — Should be done while the engine is still warm to assure that all contaminants are ____________ in the oil so they will drain out; do this last

4. Complete statements concerning spark plug inspection by inserting the word(s) that best completes each statement.

a. The condition of the ____________ ____________ can provide valuable clues to engine problems, so ____________ ____________ should always be removed and inspected as the first step in engine tune-up.

b. To indicate normal wear, the spark plug insulator will be ____________, ____________, or, if unleaded fuel is used, ____________.

c. ____________ ____________ will be proportionate to the number of miles of service.

d. Normal coloration and wear in a spark plug indicates that the engine is performing well and that the spark plug is of suitable ____________ ____________.

e. If an insulator appears ____________ ____________ and ____________, it means the cylinder is overheating.

f. Conditions that can cause spark plug overheating are:

1) Advanced ignition ____________

2) ____________ carburetor

3) Intake air ____________

4) Wrong spark plug ____________ ____________

5) ____________ air/fuel mixture

TEST

g. If an insulator appears ____________ and ____________, it may indicate that the engine air-fuel mixture is too rich or that the rings are bad and letting oil into the combustion chamber.

h. New spark plugs should be inspected for proper ____________, and the ____________ should be reset if it does not meet specifications in the service manual.

5. Select true statements concerning valve adjustment by placing an "X" beside each statement that is true.

_____a. Motorcycle engine valve adjustments are not necessary to provide a small amount of clearance between the valve stem and the rocker arm or camshaft.

_____b. The valve clearance is not necessary so that the valve will completely seat on the engine valve seat and compensate for component expansion caused by engine heat.

_____c. Exhaust valves usually require more clearance than intake valves because they get hotter than intake valves.

_____d. Rocker arms are mechanical means to open valves, and springs are the mechanical means of closing valves, so rocker arms and springs must be in good condition.

_____e. Valve clearance adjustments are usually made with an adjusting screw secured by a lock nut or by changing the thickness of a shim between the camshaft and valve stem.

_____f. Valve shims come in a wide range of thicknesses, and can be easily selected to adjust valves to the clearances required of different engines.

_____g. Always install valve shims with the marking toward the cam shaft so the markings will not be worn off by the camshaft, and technicians servicing the valves at a later date will know what size shim was there.

6. Complete statements concerning cam chain adjustment by inserting the word(s) that best completes each statement.

a. A properly tensioned cam chain will insure that the ____________ operate in time with ____________ movement.

b. Excessive play in a ____________ ____________ will cause erratic valve timing.

c. Excessive play in a ____________ ____________ will cause premature wear to the tensioning device, cam chain guides, rollers, sprockets, and the chain itself.

TEST

d. Excessive ____________ can be detected by the slapping sound a chain makes at low engine rpm's.

e. Cam chain tension is usually adjusted automatically by a ____________ or ____________ ____________ ____________.

f. Cam chain tension adjustments vary greatly from model to model, and it's one service area where a technician should always consult the appropriate ____________ ____________.

7. Complete statements concerning ignition timing by inserting the word(s) which best completes each statement.

a. Ignition timing is important to engine performance because the spark in the combustion chamber must occur at a precise instant related to ____________ ____________.

b. As ____________ ____________ increases, the spark must occur at a point in advance of TDC.

c. Igniting the ____________ ____________ sooner allows the fuel to burn completely by the time the piston reaches TDC, and this exerts maximum force on the piston to push it back down the cylinder.

d. If ignition occurs too far in advance of TDC, it causes excessive forces on the piston which can be detected by the sounds of ____________ or ____________.

8. Complete statements concerning ignition timing marks by inserting the word(s) that best completes each statement.

a. Ignition timing marks are found on the ____________ or on the ____________ ____________.

b. Ignition timing marks are always referenced to a fixed mark on the ____________ ____________ or the ____________ ____________ ____________.

c. There are three types of ignition timing marks:

1) T means TDC, and when T is lined up with the ____________ ____________, the cylinder is at top dead center.

2) F is a timing mark for ____________ ____________ ____________, and it should align with the index mark when the engine is idling.

3) The two other timing marks that are close together indicate the ____________ of advanced timing and the ____________ ____________ should align with or be in between these two marks when the engine is running at high rpm.

TEST

d. Timing advance is controlled automatically by an ____________ unit that has to be replaced if it is bad because it cannot be adjusted.

e. Some ignition units can be moved by hand for ____________ ____________, but most ignition units are fixed and cannot be adjusted.

9. Complete statements concerning air filter service by inserting the word(s) that best completes each statement.

a. The purpose of an air filter is to trap ____________ and ____________ that would otherwise get into the engine and cause rapid wear and premature component failures.

b. A clean air supply of sufficient ____________ is critical to good engine performance.

c. The air filter should always be checked and serviced or replaced on a periodic basis and should always be checked when the engine is ____________ ____________.

d. There are two types of motorcycle filters and each demands a specific type of service:

1) ____________ filters are usually found on street bikes that are ridden mostly on paved surfaces.

2) Dry-element filters are made of ____________ and ____________ ____________ and can sometimes be blown out and reused.

3) Dry-element filters should never be washed in water or solvent because it will ruin the ____________ ____________ ____________ element.

4) Foam rubber or washable gauge filters are usually found on ____________ ____________ or ATV's that are ridden in ____________ or ____________ conditions.

5) Foam and washable gauge filters work because they are saturated with special ____________ that dust particles readily stick to.

6) Foam and washable gauge filters can usually be ____________ again after cleaning.

e. Air filters are usually housed in an ____________ ____________ that may be under the seat or in a protected area that will permit unrestricted air flow.

TEST

10. Select true statements concerning crankcase ventilation by placing an "X" beside each statement that is true.

_____a. Crankcase ventilation is necessary to exhaust gases that blow by the rings during the combustion process, and prevents pressure build-up that could cause crankcase oil leaks.

_____b. Crankcase ventilation is in the area where the oil is contained, so crankcase ventilation must be designed to exhaust only air and gas, but no oil.

_____c. Sometimes crankcase ventilation is ducted into the air box so that the escaping gases and fumes will be pulled into the engine and burned.

_____d. The crankcase ventilation system is so designed that it is usually maintenance free, but sometimes the hose that leads from the crankcase to the air box will come off, wear out, or get kinked, and in that case, the hose should be replaced.

11. Complete statements concerning carburetor adjustment by inserting the word(s) that best completes each statement.

a. Carburetor adjustment is seldom necessary because carburetors are preset at the factory, and have ____________ devices that must be removed to make adjustments.

b. The adjustments that can be made with the ____________ ____________ generally affect the idle or slow-speed circuit and no other adjustment is usually necessary.

c. When fine tuning a carburetor, the idle drop method based on engine rpm can be used, but analyzing exhaust emissions with a ____________ is also an acceptable procedure.

d. Carburetor adjustments do affect ____________ ____________ ____________, and adjustments should never result in conditions that do not meet EPA standards.

12. Complete statements concerning carburetor synchronization by inserting the word(s) that best completes each statement.

a. Multi-cylinder engines that use more than one carburetor must sometimes have the carburetors ____________ so that all carburetors are performing on an equal level.

b. ____________ carburetors will cause the engine to run roughly, cause the engine to backfire during deceleration, and generally perform poorly.

TEST

c. Carburetors can be synchronized with two different kinds of equipment:

1) The __________ __________ is probably the most commonly used because it's a relatively __________ piece of equipment.

2) The __________ __________ also provides highly __________ results that are easy to compare.

3) Most of all, the __________ __________ is highly __________.

4) A __________ __________ set accomplishes the same thing as a carb stick, but comparing results is sometimes difficult.

5) Both instruments are __________ and must be handled with care because a dropped vacuum gauge would probably have to be replaced, and a dropped carb stick would probably __________ __________ __________.

d. NEVER rev an engine when your're synchronizing carburetors and have a carb stick hooked up because the increase in manifold vacuum would pull the __________ from the carb stick into the engine and exhaust it as poisonous mercury gas.

e. Always use or store a carb stick in a __________ position to prevent __________ from spilling out.

13. Complete statements concerning oil and filter service by inserting the word(s) that best completes each statement.

a. Oil should be changed at regular intervals related to __________ and the __________ __________ __________ for which the motorcycle is used.

b. The oil filter should always be changed when the __________ is changed.

c. Oil selection should be made on the basis of __________ __________ and should always be top-quality oil.

d. Oil drain plugs and filter bolts should always be __________ to specifications.

e. The engine should always be __________ before starting an oil change, and the most desirable time for an oil change is shortly after a motorcycle has been __________.

f. Keep motor oil off your hands as much as possible during oil and filter service because most oils contain __________ and __________ that can be both irritating and damaging to the skin.

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

14. Select proper shim thicknesses for shim-type valve adjustment. (Assignment Sheet #1)

15. Demonstrate the ability to:

    a. Perform a compression test on a motorcycle engine. (Job Sheet #1)

    b. Perform a leak-down test on a motorcycle engine. (Job Sheet #2)

    c. Adjust the valves on a motorcycle engine. (Job Sheet #3)

    d. Adjust cam chain tension. (Job Sheet #4)

    e. Inspect ignition timing. (Job Sheet #5)

    f. Service an air filter. (Job Sheet #6)

    g. Adjust a motorcycle carburetor using an exhaust gas analyzer. (Job Sheet #7)

    h. Synchronize carburetors on a multi-cylinder motorcycle engine. (Job Sheet #8)

    i. Change engine oil and filter. (Job Sheet #9)

BASIC ENGINE TUNE-UP
UNIT XVI

ANSWERS TO TEST

1.
   a. 5
   b. 4
   c. 8
   d. 1
   e. 6
   f. 3
   g. 7
   h. 2

2.
   a. Mechanical wear, damage
   b.
      1) Oily, excessive smoke
      2) Saturated
      3) Engine
      4) Spark plugs
      5) Oil
      6) Cylinders
   c. Tested for compression, leak-down test

3.
   a. Condition
   b. Cold
   c. Carburetor adjustment
   d. Cam chain adjustment, carburetor adjustment
   e. Carburetor adjustment
   f. Filters, valves
   g. Carburetors
   h. Air-fuel mixture
   i. Suspended

4.
   a. Spark plugs, spark plugs
   b. Brown, tan, gray
   c. Electrode wear
   d. Heat range
   e. Chalk white, blistered
   f.
      1) Timing
      2) Clogged
      3) Leaks
      4) Heat range
      5) Lean
   g. Black, oily
   h. Gap, gap

5. c, d, e, f

6.
   a. Valves, piston
   b. Cam chain
   c. Cam chain
   d. Play
   e. Spring, engine oil pressure
   f. Service manual

ANSWERS TO TEST

7. a. Engine rpm
   b. Engine rpm
   c. Air-fuel mixture
   d. Knocking, pinging

8. a. Flywheel, alternator rotor
   b. Engine case, timing plug hole
   c. 1) Index mark
      2) Low engine speed
      3) Range, index mark
   d. Advancer
   e. Minor adjustment

9. a. Dust, dirt
   b. Volume
   c. Tuned up
   d. 1) Dry-element
      2) Paper, wood pulp
      3) Paper-wood pulp
      4) Dirt bikes, dusty, muddy
      5) Oil
      6) Used
   e. "Air box"

10. a, b, c, d

11. a. Anti-tampering
    b. Pilot screw
    c. Meter
    d. Exhaust emission standards

12. a. Synchronized
    b. Unsynchronized
    c. 1) Carb stick, inexpensive
       2) Carb stick, visible
       3) Carb stick, accurate
       4) Vacuum gauge
       5) Delicate, break into pieces
    d. Mercury
    e. Vertical, mercury

13. a. Mileage, type of service
    b. Oil
    c. Seasonal temperatures
    d. Torqued
    e. Warm, ridden
    f. Detergents, hydrocarbons

14. Evaluated to the satisfaction of the instructor

15. Performance skills evaluated by practical tests

BASIC CHASSIS TUNE-UP
UNIT XVII

UNIT OBJECTIVE

After completion of this unit, the student should be able to list guidelines for chassis tune-up and discuss control cable routing and detailing. The student should also be able to remove, lubricate, and replace control cables and detail a motorcycle or an ATV. These competencies will be evidenced by correctly completing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to basic chassis tune-up with their correct definitions.
2. Complete statements concerning guidelines for chassis tune-up.
3. Select true statements concerning control cables.
4. Complete statements concerning detailing.
5. Demonstrate the ability to:
    a. Remove, lubricate, and replace control cables. (Job Sheet #1)
    b. Detail a motorcycle or an ATV. (Job Sheet #2)

BASIC CHASSIS TUNE-UP
UNIT XVII

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparency.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheets.

G. Invite a local dealer or sales manager to talk to students about the importance of detailing.

H. Demonstrate cable routing and impress on students the hazards that can be created with improper cable routing.

I. Walk through a complete chassis tune-up and explain the importance of each item.

J. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hein, Jim, and Mike Bundy. *Motorcycle Repair.* Stillwater, OK 74074: Mid-America Vocational Curriculum Consortium, 1977.

B. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics.* New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

C. Johns, Bruce A., and David D. Edmundson. *Motorcycles Fundamentals, Service, Repair.* South Holland, IL: The Goodheart-Willcox Co., Inc., 1984.

D. *Honda Shop Manual '78-'81 CB/CM400's.* Gardena, CA: Honda Motor Co., Ltd., 1980.

BASIC CHASSIS TUNE-UP
UNIT XVII

INFORMATION SHEET

I. **Terms and definitions**

   A. Detailing — Thoroughly cleaning and polishing a vehicle paying attention to every detail

   B. Routing — The path that a control cable makes from a control point to terminal points through guide positions that assure the cable will not be kinked, pinched, or burned, and operate freely

   C. Pivot bolt — The control-lever bolt that attaches the lever to its mount

   D. Pivot point — The point where a control cable attaches to a control lever so that the cable can swivel without bending

II. **Guidelines for chassis tune-up**

   A. Inspect and lubricate all the control cables.

   B. Adjust free play for the clutch, brake and throttle.

   C. Look the motorcycle over thoroughly for loose bolts, nuts, and other fasteners.

   D. Inspect the drive chain and sprockets for damage or excessive wear.

   E. Lubricate and adjust the drive chain.

   F. Inspect the horn, lights, and other safety equipment.

   G. Check wheels for damage or loose spokes.

   H. Check tires and inflate them to proper pressure.

   I. Check the condition and the level of water levels, brake fluid levels, and oil levels.

   J. Check the headlight for proper aiming.

   K. Lubricate the chassis as outlined in the service manual.

   L. Complete the job with a cosmetic wipe-down to remove any oily fingerprints.

INFORMATION SHEET

III. **Control cables** (Transparencies 1 and 2)

A. Control cables provide the mechanical linkage for operating the clutch, brakes, and throttle.

B. Some control cables are Teflon-coated and require no lubricant.

C. Cables must be kept free from short bends and hot surfaces around the engine and exhaust systems.

D. Control cables need to be lubricated with chain lube or oil at their upper and lower pivot points to avoid bending the cable back and forth and breaking it.

E. Always use the original cable as a routing guide when installing new cables.

(NOTE: To avoid the possibility of improper routing, install the new cable alongside the old cable before removing the old cable.)

F. If a control cable passes underneath a gas tank, always remove the gas tank to make sure the cable is properly installed.

G. Replacement cables should always be of a quality equal to original equipment.

IV. **Detailing**

A. Detailing is one of the first jobs that an entry-level technician will perform, and is important because it is where the employer can immediately evaluate performance.

B. Detailing should be so meticulous that each individual spoke is wiped clean and polished.

C. A good detailer will remove dirt and grime along cracks and crevices because a shiny fender still looks bad if there's dirt along its attaching points.

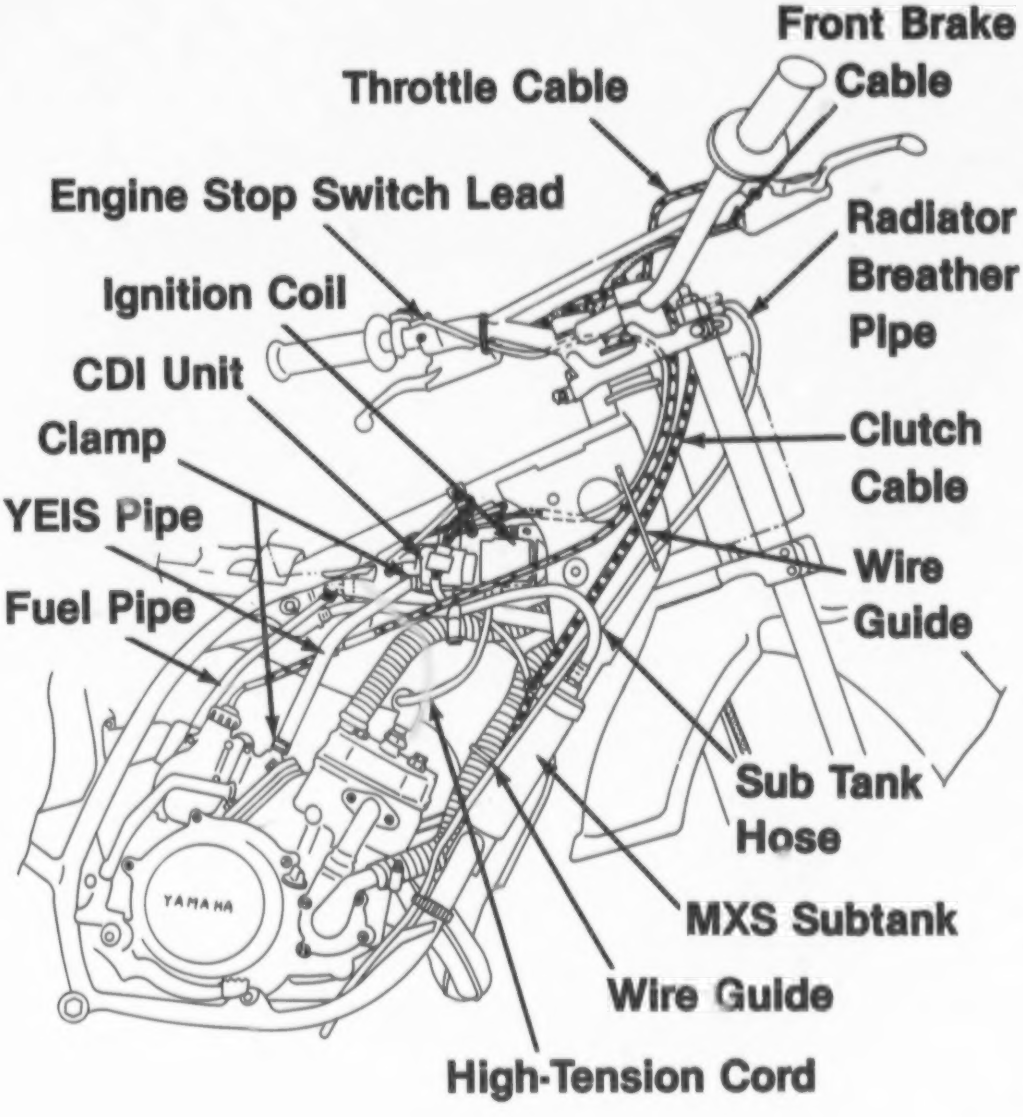
D. Never use a rubber restorer such as Armor-All on seats or handle grips because it will make them so slippery that they will be dangerous.

E. Never use spray on wax because it penetrates into places where it should not be, and it is much easier to keep wax off than to remove it.

F. Flat black surfaces and all nonglossy finishes should not be waxed because the wax will leave a white film that is almost impossible to remove.

G. Remember that a good, clean motorcycle is worth more than a good, dirty motorcycle.

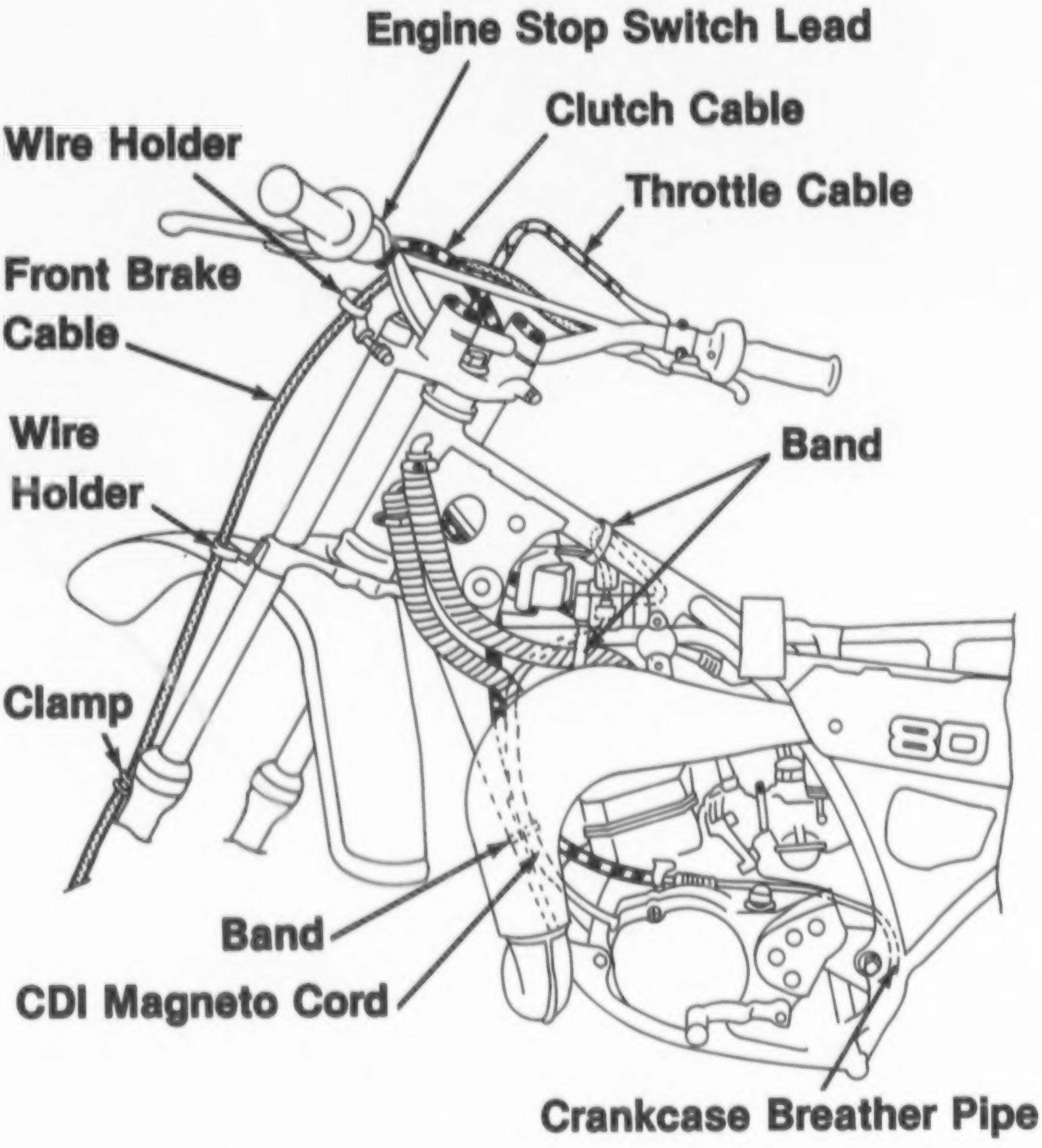
Control Cable Routing


Front Brake Cable
Throttle Cable
Engine Stop Switch Lead
Radiator Breather Pipe
Ignition Coil
CDI Unit
Clutch Cable
Clamp
YEIS Pipe
Wire Guide
Fuel Pipe
YAMAHA
Sub Tank Hose
MXS Subtank
Wire Guide
High-Tension Cord

Courtesy Yamaha Motor Corporation, U.S.A.

Control Cable Routing

(Continued)


Engine Stop Switch Lead
Clutch Cable
Wire Holder
Throttle Cable
Front Brake Cable
Wire Holder
Band
Clamp
80
Band
CDI Magneto Cord
Crankcase Breather Pipe

Courtesy Yamaha Motor Corporation, U.S.A.

BASIC CHASSIS TUNE-UP
UNIT XVII

JOB SHEET #1 — REMOVE, LUBRICATE, AND REPLACE CONTROL CABLES

A. Tools and materials

1. Motorcycle or ATV as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Oil can or chain lubricant
6. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Secure the vehicle in an upright position.
3. Check the vehicle for proper routing of all control cables and follow the appropriate routine:
    a. If the old control cables do not need to be replaced, lubricate them at the top pivot point on the handlebars or brake pedal and the bottom pivot point at the brake, clutch, or throttle, and be sure to lubricate the pivot bolt on the control lever.
    b. If cables have to be replaced, leave the old cables in place until the new cables are installed and properly connected to their pivot points, and only then remove the old cables and lubricate the new cable pivot points.
4. Check new cables to make sure they are securely fastened. (Figure 1)

FIGURE 1

JOB SHEET #1

5. Adjust clutch free play by turning the handlebar adjustment in almost all the way. (Figure 2)

FIGURE 2

6. Make the initial clutch adjustment at the center cable adjustor (if it is that type) or at the adjustor on the clutch arm end. (Figure 3)

FIGURE 3

7. Adjust the brake cable with the same procedure used for clutch adjustment. (Figure 4)

FIGURE 4

JOB SHEET #1

8. Adjust the throttle cable in much the same way with the adjustment made at the carburetor so the customer will have the convenience of making fine adjustments at the handlebar.

   (NOTE: If you're adjusting a dual-carburetor control cable, a slight amount of free movement should be left at the throttle to promote smooth throttle operation.)

9. Turn the wheel hard right, hard left, and then center as you work the throttle back and forth to make sure there is no binding or sticking in any position.

10. Check the brake and clutch cables with the same procedure.

☐ Have your instructor check your work.

11. Clean up area and return tools and materials to proper storage.

BASIC CHASSIS TUNE-UP
UNIT XVII

JOB SHEET #2 — DETAIL A MOTORCYCLE OR AN ATV

A. Tools and materials

1. Vehicle as selected by instructor
2. Clean shop towels
3. Chrome cleaner
4. Mag wheel cleaner
5. Auto polish
6. Vinyl cleaner
7. High pressure washer or soap and water
8. Rubber conditioner
9. Glass cleaner
10. Plastic cleaner
11. Spray degreaser
12. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Take the vehicle to the high pressure wash station and wash it from one end to the other, being careful not to direct high pressure water onto carburetor, chains, and areas that should not be wet.
3. Pay particular attention to the areas underneath the carburetors, underneath and behind the engine, and all areas near the chain and sprocket because these are areas most subject to collecting dust and grime.
4. Make sure you clean underneath the fenders and all points not normally seen from the top side of the vehicle, and if you use a spray degreaser, follow directions carefully.
5. Dry the motorcycle thoroughly with clean shop towels or a chamois and make sure the cloth is free of foreign matter that could scratch painted and plastic surfaces.

JOB SHEET #2

6. Gather your cleaning materials together and secure the bike in an upright position so you can move about it freely. (Figure 1)

FIGURE 1

7. Start with the front wheel and clean the wheel and the spokes or the mag wheel with chrome or mag wheel cleaner, and shine it with a clean shop towel.

8. Clean the chrome exhaust with chrome cleaner and any other chrome or polished aluminum parts on the engine, chain guard, or shocks and polish with a clean shop towel.

9. Clean the rear wheel just like the front wheel but pay attention to spots of oil from the engine or drive chain because caked-on grime will require a bit more effort to remove.

10. Spray the tires with a rubber conditioner and wipe off any excess from the wheel and tire. (Figure 2)

FIGURE 2

11. Use the shop towel soaked with rubber conditioner to wipe all of the control cables, wiring covers, and any other exposed rubber parts.

JOB SHEET #2

12. Apply wax or polish to a shop towel and wax all exposed painted surfaces. (Figure 3)

    (CAUTION: Do not spray wax onto any part of the vehicle; if you're using a spray wax, apply it to a clean shop towel before using because wax overspray will get into areas where it is impossible to remove and look tacky.)

    FIGURE 3

13. Clean and shine all parts of the vehicle that you can see, and remember that detailing means cleaning and polishing all of the vehicle, not just the gas tank and fenders. (Figure 4)

    FIGURE 4

14. Clean the headlight, taillight, and mirrors with glass cleaner and make sure they shine.

JOB SHEET #2

15. Clean the seat and other vinyl surfaces with vinyl cleaner, not rubber conditioner. (Figure 5)

    (CAUTION: Using a rubber conditioner on vinyl will make the vinyl surface so slick that it could pose a hazard to a rider.)

FIGURE 5

16. Wipe the vinyl cleaner off with a clean shop towel.

17. Inspect the vehicle from several different angles and clean and detail any areas that you may have missed.

18. Remove any excess wax or polish that you may have missed. (Figure 6)

FIGURE 6

☐ Have your instructor admire your work.

19. Clean up area and return tools and materials to proper storage.

BASIC CHASSIS TUNE-UP
UNIT XVII

PRACTICAL TEST #1
JOB SHEET #1 — REMOVE, LUBRICATE, AND REPLACE CONTROL CABLES

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Checked cables for secure fastening.	2.	☐	☐
3. Adjusted clutch cable free play.	3.	☐	☐
4. Adjusted throttle cable properly.	4.	☐	☐
5. Verified free front wheel movement.	5.	☐	☐
6. Checked brake and clutch cables for operation.	6.	☐	☐
7. Cleaned area and returned tools to storage.	7.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BASIC CHASSIS TUNE-UP
UNIT XVII

PRACTICAL TEST #2
JOB SHEET #2 — DETAIL A MOTORCYCLE OR AN ATV

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Washed vehicle properly.	2.	☐	☐
3. Checked underneath fenders and other underside areas.	3.	☐	☐
4. Used degreaser properly.	4.	☐	☐
5. Cleaned wheels with proper cleaner.	5.	☐	☐
6. Cleaned exhaust with proper cleaner.	6.	☐	☐
7. Used proper tire conditioner.	7.	☐	☐
8. Waxed and shined all painted surfaces.	8.	☐	☐
9. Cleaned all glass.	9.	☐	☐
10. Cleaned vinyl surfaces properly.	10.	☐	☐
11. Cleaned area and returned tools to storage.	11.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

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BASIC CHASSIS TUNE-UP
UNIT XVII

NAME ______________________

TEST

1. Match terms related to basic chassis tune-up with their correct definitions.

   _____a. Thoroughly cleaning and polishing a vehicle paying attention to every detail

   _____b. The path that a control cable makes from a control point to terminal points through guide positions that assure the cable will not be kinked, pinched, or burned, and operate freely

   _____c. The control-lever bolt that attaches the lever to its mount

   _____d. The point where a control cable attaches to a control lever so that the cable can swivel without bending

   1. Routing
   2. Pivot point
   3. Detailing
   4. Pivot bolt

2. Complete statements concerning guidelines for chassis tune-up by inserting the word(s) that best completes each statement.

   a. Inspect and ____________ all the control cables.

   b. Adjust ____________ ____________ for the clutch, brake and throttle.

   c. Look the motorcycle over thoroughly for ____________ ____________, ____________, and other ____________.

   d. Inspect the drive ____________ and ____________ for damage or excessive wear.

   e. ____________ and ____________ the drive chain.

   f. Inspect the ____________, ____________, and other ____________ ____________.

   g. Check wheels for damage or loose ____________.

   h. Check tires and ____________ them to proper pressure.

   i. Check the condition and the level of ____________ levels, ____________ ____________ levels, and ____________ levels.

TEST

j. Check the headlight for proper ____________.

k. Lubricate the ____________ as outlined in the service manual.

l. Complete the job with a cosmetic wipe-down to remove any ____________ ____________.

3. Select true statements concerning control cables by placing an "X" beside each statement that is true.

_____a. Control cables provide the mechanical linkage for operating the transmission, brakes, and throttle.

_____b. Some control cables are Teflon-coated and require no lubricant.

_____c. Cables must be kept free from short bends and hot surfaces around the engine and exhaust systems.

_____d. Control cables need to be lubricated with chain lube or oil at their upper and lower pivot points to avoid bending the cable back and forth and breaking it.

_____e. Always use the original cable as a routing guide when installing new cables.

_____f. If a control cable passes underneath a gas tank, always remove the gas tank to make sure the cable is properly installed.

_____g. Replacement cables should never be of a quality equal to original equipment.

4. Complete statements concerning detailing by inserting the word(s) that best completes each statement.

a. Detailing is one of the first jobs that an ____________ ____________ technician will perform and is important because it is where the employer can immediately evaluate performance.

b. Detailing should be so meticulous that each individual ____________ is wiped clean and polished.

c. A good detailer will remove dirt and grime along cracks and crevices because a ____________ ____________ still looks bad if there's dirt along its attaching points.

d. Never use a ____________ ____________ such as Armor-All on seats or handle grips because it will make them so slippery that they will be dangerous.

TEST

e. Never use spray on wax because it ____________ into places where it should not be, and it is much easier to keep wax off than to remove it.

f. Flat black surfaces and all nonglossy finishes should not be waxed because the wax will leave a ____________ ____________ that is almost impossible to remove.

g. Remember that a good, clean motorcycle is ____________ ____________ than a good, dirty motorcycle.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

5. Demonstrate the ability to:

   a. Remove, lubricate, and replace control cables. (Job Sheet #1)

   b. Detail a motorcycle or an ATV. (Job Sheet #2)

BASIC CHASSIS TUNE-UP
UNIT XVII

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 4
   d. 2

2. a. Lubricate
   b. Free play
   c. Loose bolts, nuts, fasteners
   d. Chain, sprockets
   e. Lubricate, adjust
   f. Horn, lights, safety equipment
   g. Spokes
   h. Inflate
   i. Water, brake fluid, oil
   j. Aiming
   k. Chassis
   l. Oily fingerprints

3. b, c, d, e, f

4. a. Entry-level
   b. Spoke
   c. Shiny fender
   d. Rubber restorer
   e. Penetrates
   f. White film
   g. Worth more

5. Performance skills evaluated by practical tests

motorcycle

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

UNIT OBJECTIVE

After completion of this unit, the student should be able to list guidelines for receiving a new vehicle, uncrating a new vehicle, assembling a new vehicle, and preparing a new vehicle for delivery. The student should also be able to uncrate a new vehicle and prepare it for assembly, assemble a new vehicle, and prepare a vehicle for delivery. These competencies will be evidenced by correctly completing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to assembly and pre-delivery with their correct definitions.
2. Complete statements concerning receiving a new vehicle.
3. Complete statements concerning guidelines for uncrating.
4. Select true statements concerning guidelines for assembly.
5. Complete statements concerning guidelines for preparing a new vehicle for delivery.
6. Complete a list of guidelines for test riding a new vehicle.
7. Demonstrate the ability to:
    a. Uncrate a new motorcycle and prepare it for assembly. (Job Sheet #1)
    b. Assemble a new vehicle. (Job Sheet #2)
    c. Prepare a new motorcycle for delivery. (Job Sheet #3)

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Discuss unit and specific objectives.

D. Discuss information sheet.

E. Demonstrate and discuss the procedures outlined in the job sheets.

F. Arrange to visit a dealership on a day when new vehicles are being unloaded, uncrated, and assembled, and have student report on different aspects of the procedures with special emphasis on safety.

G. Demonstrate how to use an assembly and preparation checklist for inspecting a vehicle.

H. Obtain an assortment of assembly and preparation manuals from a dealer and go through them with students, pointing out assembly procedures, warnings, cautions, and notes.

I. Invite a dealer to talk to the students about the problems with improper assembly which result in customer dissatisfaction or sometimes operator injuries that result in liable suits against the dealership.

J. Use video tapes as appropriate for visual reinforcement of objectives and job sheets. S1620—*PDI and Set Up* is available at an educational rate in ½" VHS or Beta video tapes from:

American Honda Motors Co., Inc.
Motorcycle VoTech
100 West Alondra Blvd.
Gardena, CA 90248-2702

K. Another video tape to reinforce this unit is *New Motorcycle Assembly and Preparation*. This video is available in ¾" U-Matic, ½" Beta I, ½" Beta II, or ½" VHS format from:

Kawasaki Motors Corp., U.S.A.
Service Training
9950 Jeronimo Road
Irvine, CA 92718-2016

L. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics*. New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

B. *Kawasaki General Motorcycle Assembly & Preparation Manual*. Santa Ana, CA: Kawasaki Heavy Industries, Ltd., 1983.

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

INFORMATION SHEET

I. **Terms and definitions**

A. Assembly manual — A book containing step-by-step instructions for safe and efficient assembly of a new vehicle

B. Assembly and preparation checklist — A list of essential assembly activities that must be checked to assure that a new vehicle performs well and operates safely

C. Anti-corrosive spray — A factory-applied coating applied to new vehicles to protect them from moisture during shipping and storage

D. Tool kit — A small pouch containing tools designed for specific models of bikes so a customer can make minor adjustments to the vehicle

II. **Receiving a new vehicle**

A. From the moment a new vehicle arrives at a dealership, it becomes the responsibility of the service department to unload, inspect, uncrate, assemble, and prepare the vehicle for delivery to a customer.

B. The shipping crate must be inspected for damage the minute it is unloaded, and any damage whatsoever must be reported immediately to the service manager.

C. Each dealership has its own receiving procedures and only authorized technicians can sign a bill of lading.

D. Crated vehicles are heavy and dangerous to handle and must be unloaded with proper equipment and safe procedures.

(CAUTION: Most unloading damage occurs because a crated vehicle is lifted too high on a fork lift, so as soon as a crate clears the truck bed, it should be lowered as far as possible before it is transported to storage.)

III. **Guidelines for uncrating**

A. When cutting strapping off a crate, be careful that the box knife does not penetrate into the crate and damage part of the vehicle.

B. Box knives are actually razor blades secured to a handle, so be careful using one because they can cut severely.

C. Never lay hammers or pry bars on top of a crate because they may fall through cracks and damage the vehicle.

INFORMATION SHEET

D. Hammer or pry with care at all times because if a tool slips it could strike and damage the vehicle.

E. Be especially watchful of nails in crating materials because they are almost as sharp as razors and can easily scratch or puncture your skin.

F. If there is a page titled "Commonly Removed Parts," the exploded view it contains should be used as a guide to part names and their locations. (Transparency 1)

G. Be sure the vehicle is safely supported at all times so it won't fall over when strapping or bracing is removed.

H. Remove metal crating with care because it has sharp edges and corners that can scratch painted surfaces.

I. Dispose of crating materials immediately because if they're left lying around, they pose a safety hazard to anyone in the area.

IV. **Guidelines for assembly**

A. Sweep the area beneath and around the vehicles before assembly begins because it will make movement around the vehicle much easier, less hazardous, and if you drop a bolt, nut, or fastener, it will be much easier to find.

B. Always leave protective pads or coverings in place over painted surfaces until assembly is complete so tools or parts that slip and fall will not damage those areas.

C. Assemble the front wheel and handlebars as soon as possible to help stabilize the vehicle and make the remainder of assembly more convenient and less hazardous.

D. Follow the assembly manual to the letter because it has been prepared by professionals to guide you through an efficient, systematic assembly that will assure a safe vehicle for the customer.

E. Examine and check off each item on the assembly and preparation checklist as you complete assembly activities because this will assure that activities essential to performance and safety have been accomplished.

V. **Guidelines for preparing a new vehicle for delivery**

A. Always remove the anti-corrosive spray from the exhaust system or other parts such as shields and covers that are subjected to extreme heat.

(NOTE: If the anti-corrosive spray is not removed, it will immediately burn onto the exhaust when the vehicle is started, and the ugly yellow coloring it leaves is almost impossible to remove.)

INFORMATION SHEET

B. Make sure the battery is serviced in advance of installation according to the battery manufacturer's recommendations.

C. Check all fluid levels and top off as required.

D. Check all control cables in all steering positions with the wheel far left, far right, and center, to make sure cables do not pull or bind.

E. Check lights and safety equipment.

F. Never rev a new engine on initial start-up because it takes a while for the lubricating oil to circulate through the engine and reach all critical parts.

G. If a new engine won't start, don't foolishly keep trying and run the battery down because it means there is a problem you should correct or seek assistance from the service manager.

H. Be sure to put the tool kit and any other complementary items in their storage compartments and secure them because they are part of the vehicle.

I. A vehicle properly prepared insures customer satisfaction, repeat business for the dealership, and job security for the technician who is skilled at assembly.

VI. **Guidelines for test riding a new vehicle**

A. Never test ride a new vehicle (or any vehicle) without first checking the brakes to make sure they are working properly.

B. Check all other controls for proper operation.

C. Look the vehicle over carefully for leaking fluids, improper assembly, or unsafe conditions.

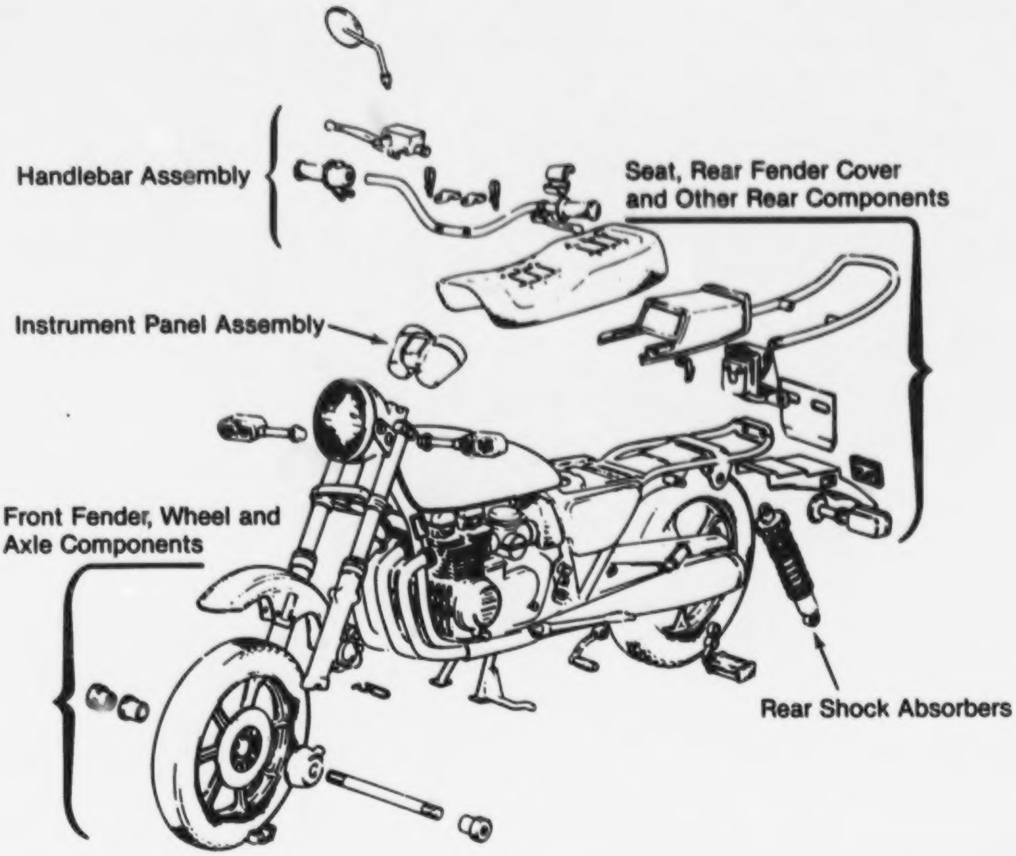
D. Listen for exhaust leaks or other engine noises that indicate problems.

E. When you get a new vehicle on the street, remember that the new tires will be slick for the first few miles, and you should avoid extreme cornering or hard braking.

F. Do not over accelerate a new engine.

G. Remember that a test ride is dedicated to making sure that everything is working properly and the vehicle is safe; a test ride should never be turned into a joy ride or a test of speed.

Commonly Removed Parts


Handlebar Assembly
Seat, Rear Fender Cover and Other Rear Components
Instrument Panel Assembly
Front Fender, Wheel and Axle Components
Rear Shock Absorbers

Courtesy Kawasaki Motors Corp., U.S.A.

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

JOB SHEET #1 — UNCRATE A NEW MOTORCYCLE AND PREPARE IT FOR ASSEMBLY

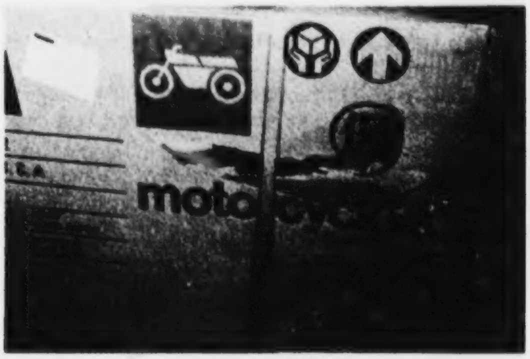
A. Tools and materials

1. Crated motorcycle
2. Appropriate assembly manual
3. Basic hand tools
4. Box knife
5. Pry bar
6. Claw hammer
7. Safe lifting assembly
8. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Inspect the crate for damage that may have occurred during shipment. (Figure 1)

FIGURE 1



JOB SHEET #1

3. Notify the service manager immediately if any damage is detected. (Figure 2)

FIGURE 2

motorcycle

4. Cut all restraining straps on motorcycles shipped in cardboard containers. (Figure 3)

FIGURE 3

YAMAHA
YAMAH

5. Pry the top off wooden containers or remove cardboard coverings. (Figure 4)

(CAUTION: The nails in wooden crates are extremely sharp and you should dispose of wooden pieces as soon as you remove them to avoid the risk of stepping on a nail.)

FIGURE 4

JOB SHEET #1

6. Remove the component packages and other parts from the crate.

7. Identify all components and packages and compare this with the inventory list that is in the assembly manual.

8. Remove nuts or bolts as required so you can remove the metal frame that is supporting the vehicle. (Figure 5)

FIGURE 5

9. Secure the vehicle so it won't fall over, or have someone hold the vehicle securely.

10. Remove braces, clamps, or restraining straps from around the vehicle. (Figure 6)

(NOTE: At this point, it may be more convenient to install the front wheel and handlebars before removing the rear restraining straps.)

FIGURE 6

11. Check for any nails that may be left sticking up where you removed wooden bracing, and bend the nails over so you or your helper will not accidentally step on one.

JOB SHEET #1

12. Use a suitable lifting device or have someone help you lift the vehicle off the bottom of the crate. (Figure 7)

    (CAUTION: Do not try, even with help, to lift a vehicle that is extremely heavy; such vehicles require special lifting slings or A-frames, so check with your service manager to find what equipment should be used to safely lift the vehicle.)

FIGURE 7

13. Secure the vehicle in an upright position so that there is no danger it will fall over. (Figure 8)

FIGURE 8

14. Check the crate bottom for parts or pieces that may have worked their way out of packages during shipment.

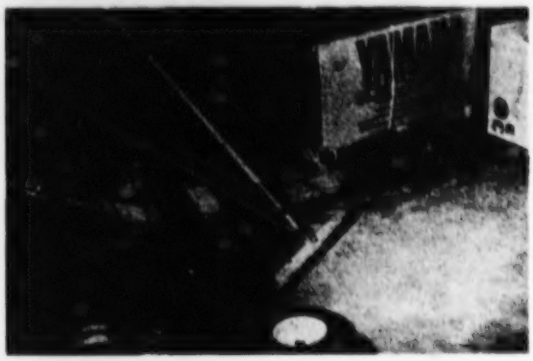
JOB SHEET #1

15. Dispose of the crate bottom. (Figure 9)

FIGURE 9

16. Sweep the area around the location where the vehicle will be assembled. (Figure 10)

FIGURE 10



☐ Have your instructor check your work.

17. Clean up area and return tools and materials to proper storage.

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

JOB SHEET #2 — ASSEMBLE A NEW VEHICLE

A. Tools and materials

1. New motorcycle prepared for assembly
2. Appropriate assembly manual
3. Basic hand tools
4. Clean shop towels
5. Torque wrench
6. Safety glasses

B. Procedure

1. Put on safety glasses.
2. Read through the assembly manual first to get a general idea of the entire assembly procedure. (Figure 1)

FIGURE 1

JOB SHEET #2

3. Follow assembly instructions in sequence, but generally, the sooner you get the wheels and handlebars on the vehicle, the easier it is to complete the rest of the assembly procedure. (Figure 2)

FIGURE 2

4. Arrange the components and their accompanying packages of fasteners in the general area of the vehicle where they will be installed. (Figure 3)

Example: The tail light assembly will have a package with bolts, nuts, and rubber grommets, and if they are placed near the rear of the motorcycle, they will be convenient and there is little chance they will be mixed up with similar fasteners.

FIGURE 3

5. Remember that the manual outlines a systematic routine that should be followed to the letter, and this systematic approach will usually have assembly begin at the front of the vehicle and work to the rear.

6. Use the assembly check list religiously and physically check off each assembly activity as you complete it.

JOB SHEET #2

7. Observe all special notices in the assembly manual:

   a. Warnings indicate procedures which, if not properly followed, could result in personal injury or loss of life. (Figure 4)

   FIGURE 4

   b. Cautions indicate procedures which, if not properly followed, could result in damage or destruction of equipment.

   c. Notes serve to clarify complex procedures and improve efficiency.

8. Ask questions of your service manager or a supervisor if you are in doubt about any assembly procedure because improper assembly could result in personal injury to the operator and subject the company to a costly liability lawsuit.

9. Use the company procedure for properly storing the battery and tool kit until the bike is prepared for delivery.

10. Wipe the vehicle down from front to back and top to bottom to make it shine. (Figure 5)

FIGURE 5

☐ Have your instructor admire your work.

11. Clean up area and return tools and equipment to proper storage.

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

JOB SHEET #3 — PREPARE A NEW MOTORCYCLE FOR DELIVERY

A. Tools and materials

1. New motorcycle, assembled
2. Appropriate assembly manual
3. Basic hand tools
4. Clean shop towels
5. New battery
6. Tool kit
7. Tire pressure gauge
8. Battery electrolyte
9. Oil as required
10. Gasoline as required
11. Brake fluid
12. Coolant
13. Safety glasses

B. Procedure

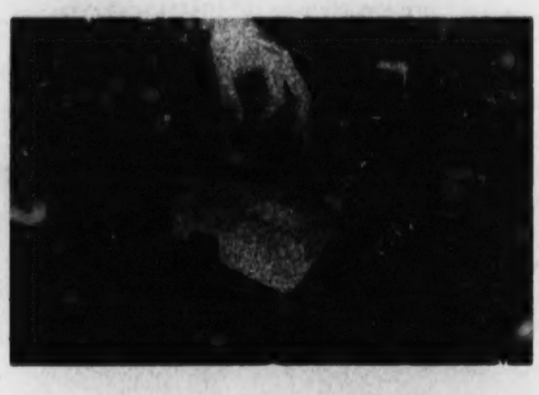
1. Put on safety glasses.
2. Secure the new motorcycle in an upright position. (Figure 1)

FIGURE 1

JOB SHEET #3

3. Select a previously serviced battery and install it in the motorcycle. (Figure 2)

FIGURE 2



4. Connect the positive cable of the battery first and the negative battery cable last. (Figure 3)

FIGURE 3

5. Drain and refill or check the oil and top it off as required. (Figure 4)

FIGURE 4

JOB SHEET #3

6. Put about a gallon of gas in the gas tank. (Figure 5)

FIGURE 5

7. Check the radiator coolant level and top off as required. (Figure 6)

FIGURE 6

8. Check air pressure in both tires and inflate as needed. (Figure 7)

FIGURE 7

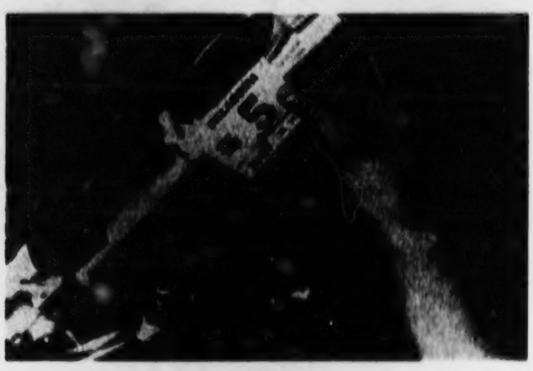
JOB SHEET #3

9. Check hydraulic fluid levels in the brake and clutch systems and top off as required. (Figure 8)

FIGURE 8

10. Check control cables for proper adjustment and readjust as required.
11. Check lights and safety equipment.
12. Check drive chain or belt for proper adjustment and readjust as required.
13. Check final drive oil and top off as required.
14. Check all nuts, bolts, cotter keys, and other fasteners.
15. Make sure the safety inspection sticker is in its proper location on the motorcycle. (Figure 9)

FIGURE 9



JOB SHEET #3

16. Wipe the entire motorcycle down with a clean shop towel, be sure to remove all anti-corrosive spray from the exhaust system, and make the bike shine. (Figure 10)

FIGURE 10

☐ Have your instructor admire your work.

17. Clean up area and return tools and materials to proper storage.

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

PRACTICAL TEST #1
JOB SHEET #1 — UNCRATE A NEW MOTORCYCLE AND PREPARE IT FOR ASSEMBLY

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Inspected crate for damage.	2.	☐	☐
3. Cut restraining straps with care.	3.	☐	☐
4. Removed crating with care.	4.	☐	☐
5. Removed component packages and compared them.	5.	☐	☐
6. Removed vehicle components safely.	6.	☐	☐
7. Assembled vehicle components safely.	7.	☐	☐
8. Disposed of crating materials safely.	8.	☐	☐
9. Swept area to clear away nails or fasteners.	9.	☐	☐
10. Cleaned area and returned tools to storage.	10.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

PRACTICAL TEST #2
JOB SHEET #2 — ASSEMBLE A NEW VEHICLE

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

> Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Read assembly manual to determine procedure.	2.	☐	☐
3. Assembled vehicle to specifications.	3.	☐	☐
4. Stored battery and tool kit as specified.	4.	☐	☐
5. Wiped vehicle down from front to back and made it shine.	5.	☐	☐
6. Cleaned area and returned tools to storage.	6.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

PRACTICAL TEST #3
JOB SHEET #3 — PREPARE A NEW MOTORCYCLE FOR DELIVERY

Student's name ______________________________ **Date** ____________

Evaluator's name ____________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:			YES	NO
1.	Wore safety glasses.	1.	☐	☐
2.	Checked and installed proper battery.	2.	☐	☐
3.	Checked oil and topped off as required.	3.	☐	☐
4.	Checked coolant level and topped off as required.	4.	☐	☐
5.	Checked air pressure in tires.	5.	☐	☐
6.	Checked control cables and safety equipment.	6.	☐	☐
7.	Checked drive chain and final drive oil.	7.	☐	☐
8.	Inspected all fasteners.	8.	☐	☐
9.	Placed safety sticker in place.	9.	☐	☐
10.	Wiped vehicle down and made it shine.	10.	☐	☐
11.	Cleaned area and returned tools to storage.	11.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #3 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

NAME ______________________

TEST

1. Match terms related to assembly and pre-delivery with their correct definitions.

_____a. A book containing step-by-step instructions for safe and efficient assembly of a new vehicle

_____b. A list of essential assembly activities that must be checked to assure that a new vehicle performs well and operates safely

_____c. A factory-applied coating applied to new vehicles to protect them from moisture during shipping and storage

_____d. A small pouch containing tools designed for specific models of bikes so a customer can make minor adjustments to the vehicle

1. Tools kit
2. Assembly and preparation checklist
3. Assembly manual
4. Anti-corrosive spray

2. Complete statements concerning receiving a new vehicle by inserting the word(s) that best completes each statement.

a. From the moment a new vehicle arrives at a dealership, it becomes the responsibility of the ____________ ____________ to unload, inspect, uncrate, assemble, and prepare the vehicle for delivery to a customer.

b. The shipping crate must be inspected for ____________ the minute it is unloaded, and any ____________ whatsoever must be reported immediately to the service manager.

c. Each dealership has its own ____________ ____________ and only authorized technicians can sign a bill of lading.

d. Crated vehicles are ____________ and ____________ to handle and must be unloaded with proper equipment and safe procedures.

3. Complete statements concerning guidelines for uncrating by inserting the word(s) that best completes each statement.

a. When cutting strapping off a crate, be careful that the ____________ ____________ does not penetrate into the crate and damage part of the vehicle.

TEST

b. ____________ ____________ are actually razor blades secured to a handle, so be careful using one because they can cut severely.

c. Never lay ____________ or ____________ ____________ on top of a crate because they may fall through cracks and damage the vehicle.

d. Hammer or pry with care at all times because if a tool slips it could ____________ and ____________ the vehicle.

e. Be especially watchful of ____________ in crating materials because they are almost as sharp as razors and can easily scratch or puncture your skin.

f. If there is a page titled "Commonly Removed Parts," the exploded view it contains should be used as a guide to ____________ ____________ and their ____________.

g. Be sure the ____________ is safely supported at all times so it won't fall over when strapping or bracing is removed.

h. Remove ____________ ____________ with care because it has sharp edges and corners that can scratch painted surfaces.

i. Dispose of ____________ ____________ immediately because if they're left lying around, they pose a safety hazard to anyone in the area.

4. Select true statements concerning guidelines for assembly by placing an "X" by each statement that is true.

_____a. Sweep the area beneath and around the vehicles before assembly begins because it will make movement around the vehicle much easier, less hazardous, and if you drop a bolt, nut, or fastener, it will be much easier to find.

_____b. Never leave protective pads or coverings in place over painted surfaces until assembly is complete so tools or parts that slip and fall will not damage those areas.

_____c. Assemble the front wheel and handlebars last to help stabilize the vehicle and make the remainder of assembly more convenient and less hazardous.

_____d. Follow the assembly manual to the letter because it has been prepared by professionals to guide you through an efficient, systematic assembly that will assure a safe vehicle for the customer.

_____e. Examine and check off each item on the assembly and preparation checklist as you complete assembly activities because this will assure that activities essential to performance and safety have been accomplished.

TEST

5. Complete statements concerning guidelines for preparing a new vehicle for delivery by inserting the word(s) that best completes each statement.

   a. Always remove the __________ __________ from the exhaust system or other parts such as shields and covers that are subjected to extreme heat.

   b. Make sure the battery is serviced in advance of __________ according to the battery manufacturer's recommendations.

   c. Check all fluid levels and __________ __________ as required.

   d. Check all __________ __________ in all steering positions with the wheel far left, far right, and center, to make sure cables do not pull or bind.

   e. Check __________ and safety equipment.

   f. Never __________ a new engine on initial start-up because it takes a while for the lubricating oil to circulate through the engine and reach all critical parts.

   g. If a new engine won't start, don't foolishly keep trying and run the battery down because it means there is a problem you should correct or seek assistance from the __________ __________.

   h. Be sure to put the tool kit and any other __________ __________ in their storage compartments and secure them because they are part of the vehicle.

   i. A vehicle __________ __________ insures customer satisfaction, repeat business for the dealership, and job security for the technician who is skilled at assembly.

6. Complete a list of guidelines for test riding a new vehicle by inserting the word(s) that best completes each statement.

   a. Never test ride a new vehicle (or any vehicle) without first checking the __________ to make sure they are working properly.

   b. Check all other __________ for proper operation.

   c. Look the vehicle over carefully for __________ __________, __________ __________, or __________ __________.

   d. Listen for exhaust leaks or other engine noises that indicate __________.

   e. When you get a new vehicle on the street, remember that the new tires will be __________ for the first few miles, and you should avoid extreme cornering or hard braking.

   f. Do not over __________ a new engine.

TEST

g. Remember that a test ride is dedicated to making sure that everything is working properly and the vehicle is safe; a test ride should never be turned into a ____________ ____________ or a ____________ ____________ ____________.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

7. Demonstrate the ability to:

   a. Uncrate a new motorcycle and prepare it for assembly. (Job Sheet #1)

   b. Assemble a new vehicle. (Job Sheet #2)

   c. Prepare a new motorcycle for delivery. (Job Sheet #3)

ASSEMBLY AND PRE-DELIVERY
UNIT XVIII

ANSWERS TO TEST

1. a. 3
   b. 2
   c. 4
   d. 1

2. a. Service department
   b. Damage, damage
   c. Receiving procedures
   d. Heavy, dangerous

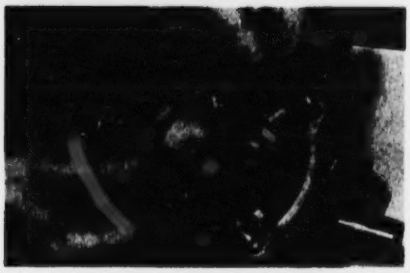
3. a. Box knife
   b. Box knives
   c. Hammers, pry bars
   d. Strike, damage
   e. Nails
   f. Part names, locations
   g. Vehicle
   h. Metal crating
   i. Crating materials

4. a, d, e

5. a. Anti-corrosive spray
   b. Installation
   c. Top off
   d. Control cables
   e. Lights
   f. Rev
   g. Service manager
   h. Complementary items
   i. Properly prepared

6. a. Brakes
   b. Controls
   c. Leaking fluids, improper assembly, unsafe conditions
   d. Problems
   e. Slick
   f. Accelerate
   g. Joy ride, test of speed

7. Performance skills evaluated by practical tests



ONE-CYLINDER ENGINE TOP-END SERVICE

UNIT XIX

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss procedures for performing top-end service on two-stroke and four-stroke motorcycle engines. The student should also be able to identify components of two-stroke and four stroke engines and disassemble, clean, inspect, and reassemble a one-cylinder four-stroke engine. These competencies will be evidenced by correctly performing the procedures outlined in the assignment and job sheets, and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to one-cylinder engine top-end service with their correct definitions.
2. Identify components of a two-stroke top end.
3. Complete a list of components of a four-stroke top end.
4. Identify components of a four-stroke cylinder head.
5. Complete a list of parts of a two-stroke piston.
6. Complete a list of parts of a four-stroke piston.
7. Identify parts of a valve.
8. Select true statements concerning guidelines for cleaning top-end components.
9. Complete statements concerning guidelines for measuring a cylinder.
10. Complete statements concerning guidelines for measuring a piston.
11. Select true statements concerning two-stroke piston rings.
12. Solve problems concerning guidelines for installing two-stroke rings.

OBJECTIVE SHEET

13. Solve problems concerning four-stroke rings.

14. Complete statements concerning special tools and materials for top-end service.

15. Select true statements concerning ring installation.

16. Complete statements concerning safety guidelines for top-end service.

17. Read and interpret wear limit information from a service manual. (Assignment Sheet #1)

18. Demonstrate the ability to:

    a. Disassemble, inspect, and reassemble a two-stroke motorcycle engine. (Job Sheet #1)

    b. Disassemble, inspect, and reassemble a four-stroke motorcycle engine. (Job Sheet #2)

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

SUGGESTED ACTIVITIES

A. Provide students with objective sheet.

B. Provide students with information sheet.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss the procedures outlined in the job sheet.

G. Show examples of unserviceable parts, and demonstrate with measurements and references to manufacturer's wear limits why the parts are no longer serviceable.

H. Show examples of piston failures caused by seizure and holes burned in the top of a piston, and explain how poor maintenance contributed to the failures.

I. Show examples of cylinder damage caused by piston seizure.

J. Show examples of how honing a cylinder will highlight normal cylinder wear and also show how much more effective it is to clean a cylinder with hot, soapy water after it has been honed (as opposed to cleaning it with solvent).

K. Use video tapes as appropriate for visual reinforcement of objectives and job sheets. S1605—*Valve Replacement and Servicing* is available at an educational rate in 1/2" VHS or Beta video tapes from:

American Honda Motors Co., Inc.
Motorcycle VoTech
100 West Alondra Blvd.
Gardena, CA 90248-2702

L. Another video to reinforce this unit is *4-Cycle Cylinder Head and Cylinder Service*. This video is available in 3/4" U-Matic, 1/2" Beta I, 1/2" Beta II, or 1/2" VHS formats from:

Kawasaki Motors Corp., U.S.A.
Service Training
9950 Jeronimo Road
Irvine, CA 92718-2016

M. Give test.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Crouse, William H., and Donald L. Anglin. *Motorcycle Mechanics.* New York City, NY: Gregg Division McGraw-Hill Book Company, 1982.

B. Johns, Bruce A., and David D. Edmundson. *Motorcycles Fundamentals, Service, Repair.* South Holland, IL: The Goodheart-Willcox Co., 1984.

C. *Official Honda Shop Manual '78-'81 CB/CM400's.* Gardena, CA: Honda Motor Co., Ltd., 1980.

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

INFORMATION SHEET

I. **Terms and definitions**

A. Elliptical — A shape which tends to be more egg-shaped than round

B. In-line — Going in the same direction as the straight length of the crankshaft

C. Top-end — All the components in a motorcycle engine going upward from the cylinder base gasket to the cylinder head

D. Wear limits — A manufacturer's specifications for the amount of wear a part can experience and still be serviceable

II. **Components of a two-stroke top end** (Transparency 1)

A. Cylinder base gasket

B. Cylinder base dowel pins

C. Cylinder base studs

D. Cylinder

E. Piston pin bearing

F. Piston pin

G. Piston pin clips

H. Piston

I. Piston rings

J. Cylinder head gasket or O-rings

K. Cylinder head dowel pins

L. Cylinder head studs

M. Cylinder head

N. Nuts, bolts, and washers

INFORMATION SHEET

III. **Components of a four-stroke top end**

- A. Cylinder base gasket
- B. Cylinder base dowel pins
- C. Cylinder studs
- D. Cylinder
- E. Piston pin
- F. Piston pin clips
- G. Piston
- H. Piston rings
- I. Cylinder head gasket
- J. Cylinder head dowel pins
- K. Cylinder head
- L. Cylinder head nuts and washers

IV. **Components of a four-stroke cylinder head** (Transparency 2)

- A. Camshaft
- B. Rocker arms
- C. Valves
- D. Spring seat washers
- E. Valve stem seals
- F. Inner valve springs
- G. Outer valve springs
- H. Valve spring retainers
- I. Valve cotters
- J. Combustion chamber
- K. Valve seats
- L. Valve guides

INFORMATION SHEET

V. **Parts of a two-stroke piston**

   A. Piston skirt
   B. Piston pin bore
   C. Piston pin bosses
   D. Piston ring lands
   E. Piston ring grooves
   F. Piston ring locating pins
   G. Top of piston
   H. Piston pin clip grooves
   I. Piston pin clips
   J. Piston pin
   K. Piston pin bearing

VI. **Parts of a four-stroke piston**

   A. Piston skirt
   B. Piston pin bore
   C. Piston pin bosses
   D. Piston ring lands
   E. Piston ring grooves
   F. Oil drain holes
   G. Top of piston
   H. Piston pin clip grooves
   I. Piston pin clips
   J. Piston pin

INFORMATION SHEET

VII. **Parts of a valve** (Transparency 3)

A. Cotter retaining groove

B. Valve stem

C. Valve face

D. Valve head

VIII. **Guidelines for cleaning top-end components**

A. Cleaning pistons, cylinders, and all internal surfaces during top-end service is an absolute requirement.

B. Dirt, grime, grit, and cuttings that stick to oily surfaces while the engine is disassembled could cause premature engine failure after overhaul.

C. Although solvent is used for the majority of cleaning, it is a petroleum product and will itself become quickly contaminated.

D. Solvent will not float particulate matter left from glass bead cleaning or cutting and grit left after honing a cylinder.

E. Hot, soapy water containing a mild dishwashing detergent is an excellent cleaner because it will float away glass bead residue and cuttings and grit.

F. Parts washed in hot, soapy water should be rinsed in clean, cold water, dried with compressed air, and immediately recovered with a coating of oil to prevent parts from rusting.

(NOTE: Rust begins to form almost the second the water dries, so getting oil on the part quickly is essential.)

IX. **Guidelines for measuring a cylinder** (Transparency 4)

A. A preliminary visual inspection should precede any other work on the cylinder because if the inspection indicates the cylinder is too bad for service, there is no need to waste time measuring.

B. Cylinders are measured at six different locations:

1. In-line with the crankshaft at the top, middle, and bottom of the cylinder

2. 90° to the crankshaft at the top, middle, and bottom of the cylinder

C. On two-stroke engines, the middle cylinder measurement should be made as close to the ports as possible.

(NOTE: Cylinder wear is easy to spot after the cylinder has been honed.)

INFORMATION SHEET

D. A small amount of cylinder wear, both out-of-round and taper, is permissable, and these wear limits are specified in the appropriate service manual.

E. Always make cylinder measurements before inspecting a piston because if the cylinder is bad it will have to be rebored and a new piston will be required.

X. Guidelines for measuring a piston (Transparency 4)

A. A preliminary visual inspection should precede any other work with the piston because if the inspection indicates the piston is too bad for service, there is no need to waste time measuring.

B. If a piston were perfectly cylindrical, it would fit the cylinder only when the engine is cold, and fit poorly when the engine is hot.

C. The piston head and ring groove area are thicker for extra strength, and the piston skirt is thin to save weight, so the differences in thickness mean a piston does not expand evenly when it heats up.

D. Because the piston expands more across the piston pin bosses than across the skirt, a piston must be elliptical and not round.

E. Because of the way a piston is made, it has to be measured with a micrometer across the skirt at 90° to the piston pin bosses, 5mm up from the bottom edge of the piston. (Figure 1)

FIGURE 1

XI. Two-stroke piston rings

A. Two-stroke engines normally have two compression rings, and do not require an oil control ring because oil is mixed with the fuel.

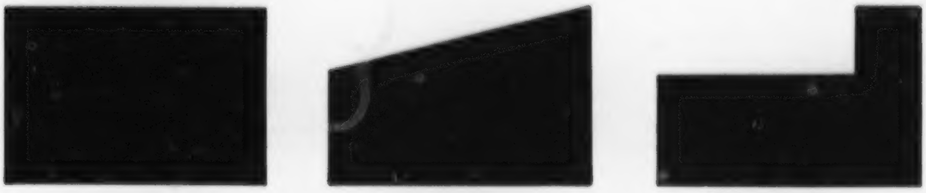
B. Two-stroke engines in racing bikes frequently have only one compression ring to cut down on friction and increase speed, but the ring wears out quickly and must be changed often.

INFORMATION SHEET

C. Two-stroke rings have three basic designs: (Figure 2)

1. Flat
2. Keystone
3. Dykes or L-shaped

FIGURE 2



Flat Keystone Dykes

XII. Guidelines for installing two-stroke rings

A. Flat rings have a rectangular cross-section and their grooves have parallel sides.

B. Flat rings are used in general duty applications such as street bikes and pleasure bikes, but flat rings are not used on racing bikes.

C. Although some flat rings can be installed either way, most flat rings have markings to indicate which side of the ring should go up.

D. Some flat rings are also marked to indicate whether the ring is the top ring or the bottom ring.

E. Flat rings marked with an "N" should have the "N" side installed up, a flat ring marked "N-1" should be installed on top, and a flat ring marked "N-2" should be installed on the bottom.

(NOTE: Some flat rings may have a dot or a star or other letters to indicate how a ring should be installed, in fact, some rings are marked "UP" to indicate the side that should go up.)

INFORMATION SHEET

F. If a flat ring has a bevel on the inside of the ring, the bevel always goes up.

G. Keystone rings are flat on bottom, but have a beveled cross-section.

H. Keystone rings are mostly used on high performance engines because they can provide a better seal at higher rpm.

(NOTE: The sloping surface provides a more open path for combustion pressure and forces the ring out harder against the cylinder wall.)

I. Keystone rings are marked the same way as flat rings with respect to what side goes up and which ring goes on top.

(NOTE: Ring sets vary and there may sometimes be a combination set with a keystone top ring and a flat ring bottom ring.)

J. Keystone rings must not be installed upside down because it would damage both the piston and the ring.

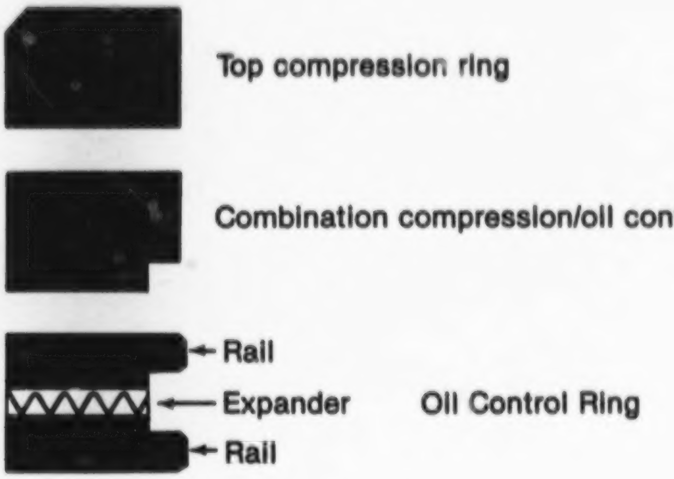
K. Dykes rings, or L-shaped rings, are used only in special racing applications and entry-level techniques will probably never see Dykes rings.

XIII. **Four-stroke rings**

A. Four-stroke motorcycle engines have three types of rings: (Figure 3)

1. Compression ring
2. Combination compression/oil control ring
3. Oil control ring

FIGURE 3



INFORMATION SHEET

B. The top ring or compression ring is made with a special chrome face to give it extra strength, and the top ring is easy to recognize because of its light-colored edge.

C. The top compression ring often has a bevel on the inside edge, and the bevel must be installed pointing up.

D. The combination compression/oil control ring is usually a plain iron ring dark in color, usually has on the outside edge a notch that points down to catch oil.

E. The oil control ring usually is made up of three pieces:

1. The expander

2. Two rail rings that fit on each side of the expander

(NOTE: The expander is a kind of spring that forces the rails out to collect oil as the piston moves down the cylinder.)

XIV. **Special tools and materials for top-end service**

A. Piston pin removing tool helps prevent damage not only to the piston pin but to the connecting rod and the piston itself.

B. A cylinder hone is used to put a cross-hatch finish on the cylinder walls, a finish that will cause the piston and rings to immediately wear the small amount required for proper seating.

C. A ring compressor is used to compress the rings so that the piston can be fitted back into the cylinder without damaging the rings.

D. A valve spring compressor is a tool used to compress valve springs so that the valve cotters can be removed.

E. Prussian Blue dye is a thin but highly-resistant coating that leaves highly accented wear patterns for evaluating valve and valve seat conditions.

F. A valve lap stick is a suction device on a convenient wooden handle so it can be stuck to the top of a valve and used to rotate the valve back and forth.

G. A piece of small-diameter rubber hose placed over the valve stem will accomplish the same thing as a valve lap stick.

H. Valve grinding compound is an abrasive material that is used in lapping the valve seat to the valve face.

INFORMATION SHEET

XV. Ring installation

A. Before installing rings, always inspect the ring grooves in the piston for carbon build-up or damage.

(NOTE: Some service manuals recommend checking ring side clearance with a feeler gauge, but a good visual inspection is normally all that is required and can save valuable time.)

B. If ring grooves need cleaning, the best thing to use is a piece of broken ring, but a glass bead cleaner is not recommended because it will damage the piston.

C. Install rings in proper order and with the correct side up.

D. On two stroke rings, be sure to place end gaps over the locating pins.

E. On four-stroke rings, it is important to make sure that the ends of the expander butt together and do not overlap.

(NOTE: This can easily happen as you fit the rails into the groove, so always check the expander a second time, and watch for pointed ends on the expander that are provided to make the job easier.)

F. A ring expander is usually used to install four-stroke rings, but is seldom used to install two-stroke rings.

XVI. Safety guidelines for top-end service

A. Because piston rings are brittle and they sometimes break into small pieces, so it's good to hold rings at a safe distance from your face.

B. Piston rings have sharp edges that can easily cut fingers and hands.

C. Cylinders have sharp edges that can cut fingers and hands, so be especially careful lubricating a cylinder after it has been honed.

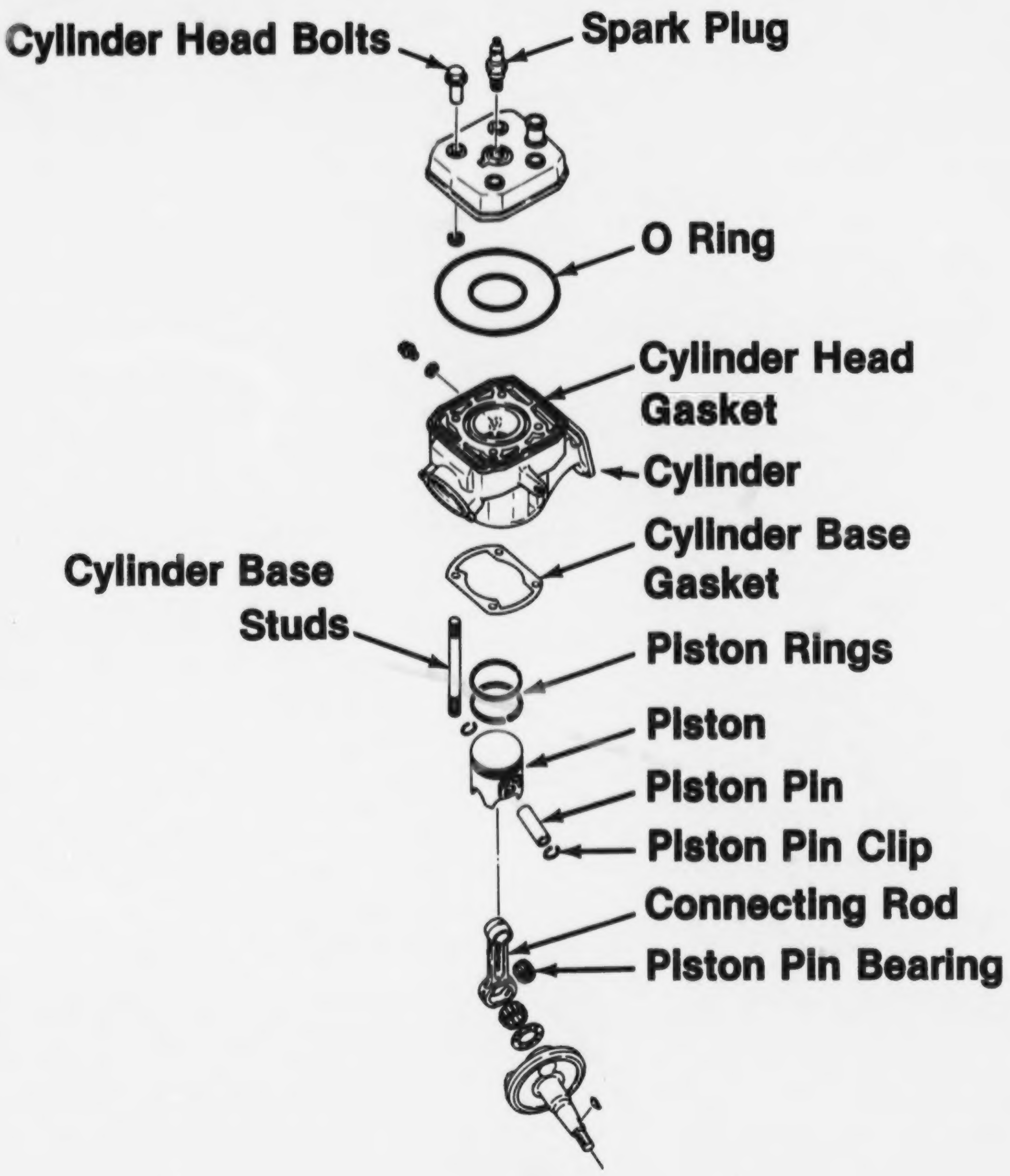
D. Valve spring compressors should be worked with care to avoid letting a spring slip because it's hard to tell where the spring might hit as it flies away.

E. Pistons have especially sharp edges on the bottom of the skirt and should be handled with care.

F. Never stick your fingers into open ports or other places where they might be exposed to danger.

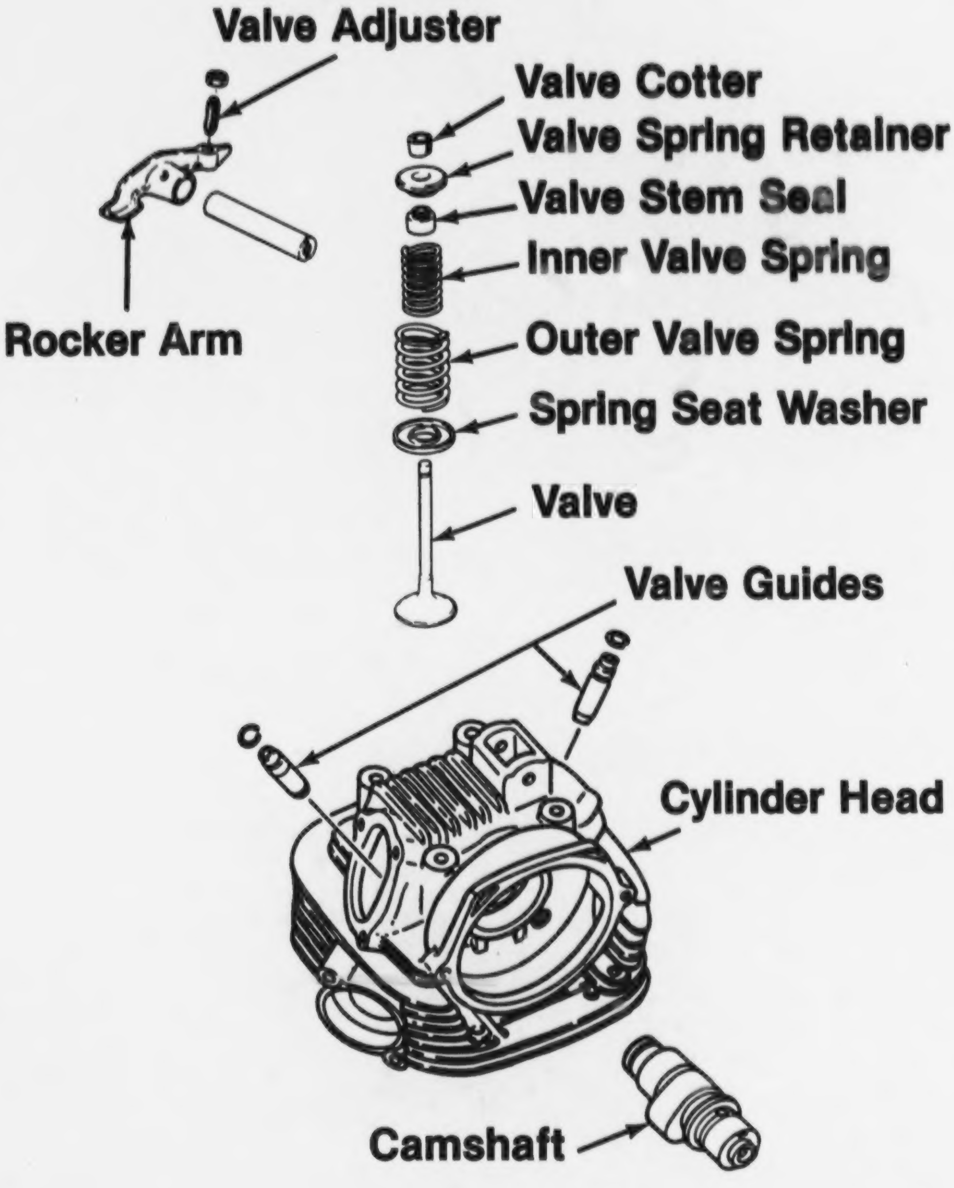
G. Piston pin clips are spring-pressure devices and will fly off almost anywhere if not contained as they're removed.

Components of a Two-Stroke Top-End

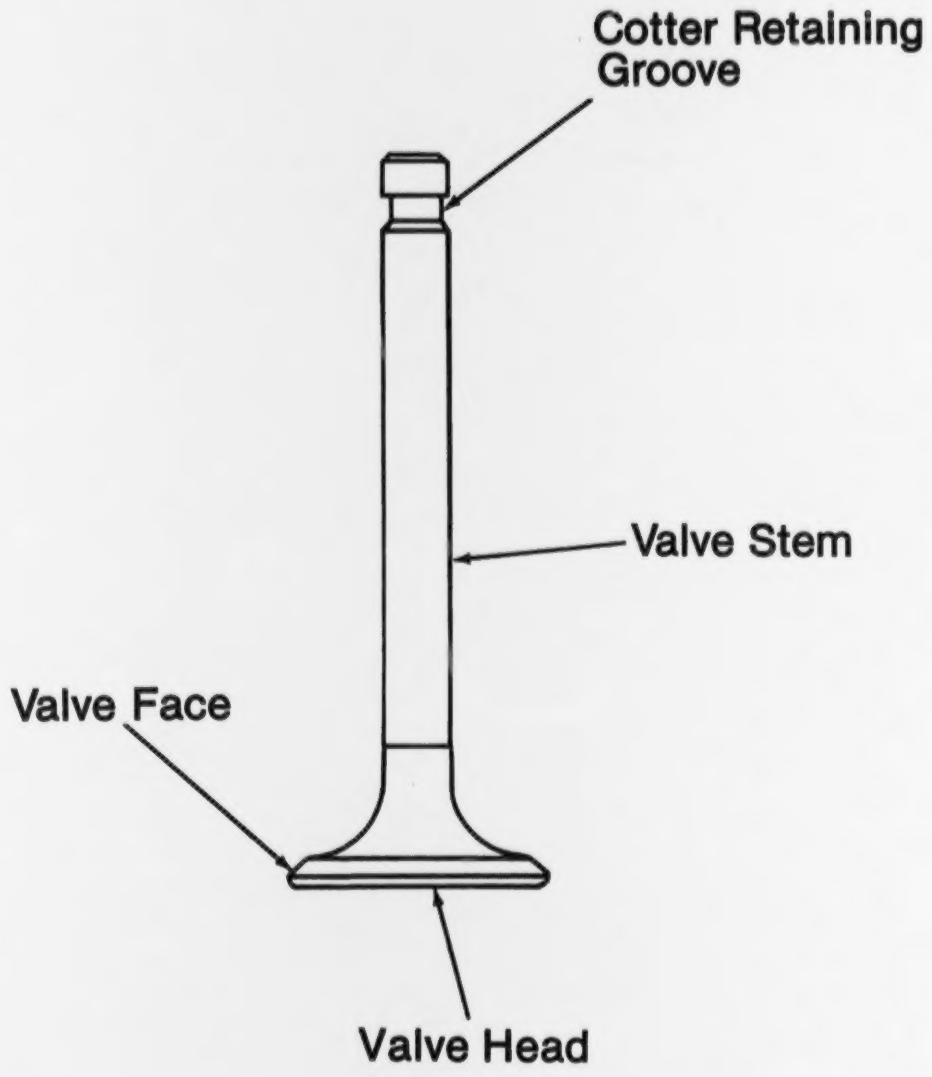

Cylinder Head Bolts
Spark Plug
O Ring
Cylinder Head Gasket
Cylinder
Cylinder Base Gasket
Cylinder Base Studs
Piston Rings
Piston
Piston Pin
Piston Pin Clip
Connecting Rod
Piston Pin Bearing

Courtesy Yamaha Motor Corporation, U.S.A.

Components of a Four-Stroke Cylinder Head

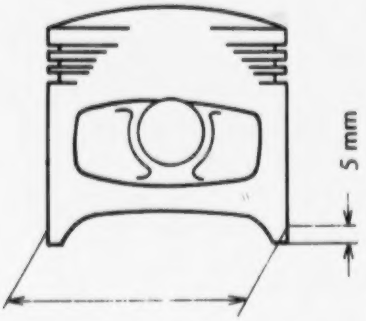

Valve Adjuster
Valve Cotter
Valve Spring Retainer
Valve Stem Seal
Inner Valve Spring
Rocker Arm
Outer Valve Spring
Spring Seat Washer
Valve
Valve Guides
Cylinder Head
Camshaft

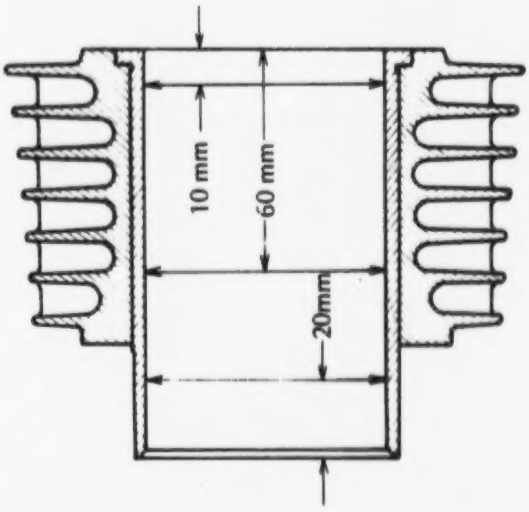
Parts of a Valve


Cotter Retaining Groove
Valve Stem
Valve Face
Valve Head

MM- 905

Cylinder and Piston Measurements




10 mm
60 mm
20mm

Courtesy Kawasaki Motors Corp., U.S.A.

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

ASSIGNMENT SHEET #1 — READ AND INTERPRET WEAR LIMIT INFORMATION FROM A SERVICE MANUAL

Directions: Read the following selected wear limit information in Figure 1 and interpret it as directed.

FIGURE 1

ITEM	SERVICE LIMIT
Cylinder inside diameter	Should be less than 67.60 mm and 0.05 mm difference between any two measurements
Piston diameter	67.30 mm
Piston ring/groove clearance	Top: 0.18 mm 2nd: 0.14 mm
Piston ring thickness	Top: 1.10 mm 2nd: 1.40 mm
Piston ring groove width	Top: 1.33 mm 2nd: 1.60 Oil: 2.61 mm
Ring end gap	0.7 mm
Piston pin, piston pin hole, small end diameter	Piston pin: 14.96 mm Pin hole: 15.08 mm Small end: 15.05 mm

A. If the cylinder ID measures 67.75mm, is it within service limits?

Answer____

B. When a cylinder wears, does the ID become smaller or larger?

Answer____

C. If the piston OD measures 67.20mm, is it within service limits?

Answer____

D. When a piston wears, does the OD become smaller or larger?

Answer____

ASSIGNMENT SHEET #1

E. If the top piston ring groove clearance measures 0.20mm, is it within wear limits?

Answer____

F. What would be an acceptable 2nd piston ring thickness measurement?

Answer____

G. If the width of the oil ring groove were 2.66mm, would it be within service limits?

Answer____

H. If the piston pin hole measures 15.70mm, is it within wear limits?

Answer____

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

ANSWERS TO ASSIGNMENT SHEET

A. No

B. Larger

C. No

D. Smaller

E. No

F. 1.40mm

G. No

H. No

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

JOB SHEET #1 — DISASSEMBLE, INSPECT, AND REASSEMBLE A TWO-STROKE MOTORCYCLE ENGINE

A. Tools and materials

1. Motorcycle engine as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Solvent cleaning tank or station
6. Mild dish washing detergent
7. Compressed air supply
8. Piston pin removing tool
9. Outside and inside micrometers
10. Gasket scraper (putty knife)
11. Glass bead cleaner
12. Cylinder hone
13. Dial bore gauge or telescoping gauge
14. Feeler gauge set
15. Squirt-type oil can and lubricant
16. Torque wrench
17. New piston pin clips, spark plugs, rings, and gaskets
18. Pencil and Top-End Service Log
19. Safety glasses

JOB SHEET #1

B. Routine #1 — Disassembling top-end components

1. Put on safety glasses.

2. Use compressed air or a high pressure washer to clean all dirt, grime, dried mud, or foreign material from the frame around the engine and especially above the engine.

   (NOTE: Compressed air will get rid of most of the dirt, but sometimes it requires hand washing with soap and water.)

3. Check the area to make sure it is free of fire hazards, and make sure there is a fire extinguisher nearby.

4. Place the motorcycle on a lift or otherwise secure it for safe engine removal.

   (NOTE Removing the engine may not be required at all, and in some cases, the gas tank does not have to be removed.)

5. Disconnect the battery ground cable and secure it.

6. Turn the fuel valve off and disconnect the fuel line from the carburetor.

7. Remove the fuel tank and set it in a protected area where it cannot fall.

8. Clean the entire engine to avoid the possibility of any foreign material getting inside the crankcase.

9. Remove the carburetor and secure it on the bike so that it is safely away from electrical components.

10. Remove the exhaust pipe.

11. Remove the spark plug.

JOB SHEET #1

12. Remove the bolts or nuts that secure the cylinder head, and if there are two sizes of bolts or nuts, remove the smallest size first. (Figure 1)

    (NOTE: If the cylinder head is torqued down and the big bolts are removed first, it places a great amount of strain on the smaller bolts and could promote premature bolt failure.)

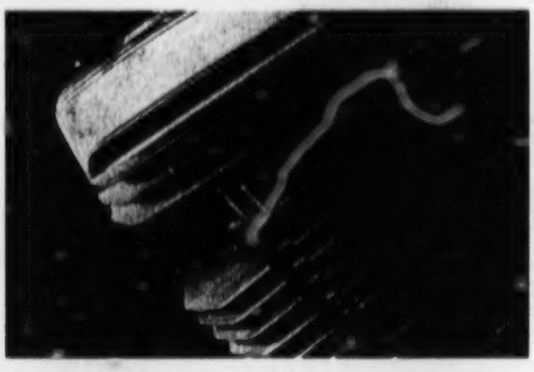
    FIGURE 1

13. Remove the cylinder head with the following precautions:

    a. Do not pry in such a way that you will break the cooling fins if it is an air-cooled engine.

    b. If the cylinder head is stuck, look around the gasket seam for indentations where a pry bar can be inserted. (Figure 2)

    FIGURE 2



    c. If there are no indentations, a putty knife can be driven into the gasket seam with a hammer.

14. Remove the cylinder head and lay it safely aside for inspection.

JOB SHEET #1

15. Remove the cylinder with the following precautions:

    a. Do not pry in such a way that you will break the cooling fins if it is an air-cooled engine.

    b. If the cylinder is stuck, look around the gasket seam for indentations where a pry bar can be inserted.

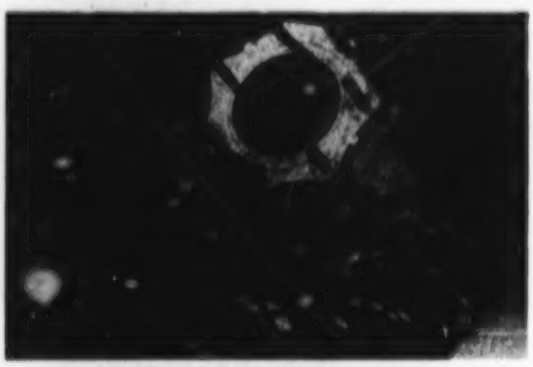
    c. A stuck cylinder can sometimes be freed by tapping with a soft-faced mallet, but you must tap from the top straight into the cylinder to avoid the damage.

    d. If there are no indentations, or the cylinder is stuck, drive a putty knife into the gasket seam, but be careful not to gouge the gasket mating surfaces.

16. Turn the crankshaft until the piston is at TDC, and then start pulling the cylinder off.

    (NOTE: The piston may be closely fitted and you may have to hold the crankshaft in place as you remove the cylinder. [Figure 3])

FIGURE 3



JOB SHEET #1

17. Pull the cylinder partially off taking care to avoid the possibility that bits of broken piston rings might fall down into the crankcase. (Figure 4)

    (NOTE: If you can tilt the cylinder forward, bits of broken rings will usually fall down on the engine and not into the crankcase.)

    FIGURE 4

18. Place the cylinder in a safe place for later inspection.

19. Place a shop towel underneath the piston to make sure the clips don't fall into the crankcase, and remove the piston pin clips. (Figure 5)

    (NOTE: Piston pin clips should be discarded and new clips only used for reassembly, but check with your instructor before discarding the clips.)

    FIGURE 5

JOB SHEET #1

20. Use a punch to push the piston pin out if it will slide out freely. (Figure 6)

(CAUTION: Do not hammer on the punch if the pin will not slide out freely.)

FIGURE 6

21. Use a piston pin removing tool to safely remove a stubborn piston pin.

22. Lay the piston and pin aside for later inspection.

23. Remove the piston pin bearing. (Figure 7)

FIGURE 7

☐ Have your instructor check your work.

JOB SHEET #1

C. Routine #2 — Cleaning and inspecting top-end components

1. Leave your safety glasses on.

2. Check the condition of the connecting rod by moving it from side to side and up and down. (Figure 8)

FIGURE 8

3. Check the service manual for rod clearance specifications, and make sure the rod does not have excessive play up and down or side to side.

   (NOTE: Some side play is acceptable, but up and down play indicates a bad connecting rod and the engine will require major overhaul.)

4. Measure the piston pin bearing bore for excessive wear according to the procedure outlined in the service manual. (Figure 9)

   (NOTE: If the piston pin bearing bore is not within service limits, the rod will have to be replaced, and the engine will require major overhaul.)

FIGURE 9

5. Check with your instructor if the condition of the connecting rod or the piston pin bearing bore is questionable because it would indicate a need for a major overhaul; however, unless directed otherwise, continue with this job sheet.

JOB SHEET #1

6. Remove all of the old gaskets with a gasket scraper or a putty knife, and make sure you don't damage the mating surfaces.

   (CAUTION: Make sure that pieces of gasket do not fall down into the crankcase, and do not use a glass bead cleaner because you could easily damage the mating surfaces.)

7. Use a glass bead cleaner to remove carbon build-up from the top of the piston only and the combustion chamber of the cylinder head. (Figure 10)

   (NOTE: If you don't have a glass bead cleaner, you'll have to carefully scrape the carbon off with a putty knife or a pocket knife, but be careful not to dig into metal surfaces on the piston head or combustion chamber.)

   FIGURE 10

8. Use soap and water to wash away glass bead residue from all surfaces, and especially threaded holes such as the spark plug hole.

9. Dry all parts with compressed air.

JOB SHEET #1

10. Scrape the large carbon deposits from the exhaust port in the cylinder, and then use a glass bead cleaner to finish cleaning the port. (Figure 11)

    (NOTE: Do not clean transfer ports or intake ports, just the exhaust port because these ports may have special coatings that should not be disturbed.)

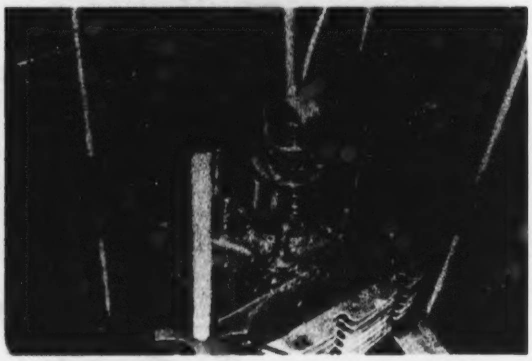
    FIGURE 11

11. Wash the entire cylinder with soap and water and dry with compressed air.

12. Inspect the cylinder first with the following procedure:

    a. Run a good-quality cylinder hone through the cylinder two or three times, but do not use a glaze breaker. (Figure 12)

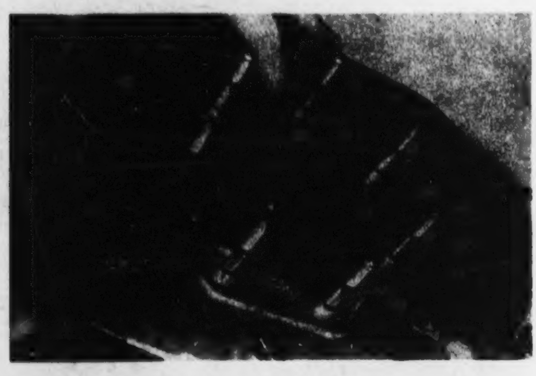
    FIGURE 12



JOB SHEET #1

b. Inspect the cylinder walls carefully because worn areas that the hone has not touched will be very evident. (Figure 13)

FIGURE 13



13. Write down the cylinder wear limits listed in the service manual onto the Top-End Service Log that accompanies this job sheet.

14. Use a dial bore gauge, telescoping gauge, or inside micrometer to measure the cylinder in six places:

    a. At the top, middle, and bottom at 90° angles from the crankshaft. (Figure 14)

FIGURE 14

JOB SHEET #1

b. At the top, middle, and bottom in line with the crankshaft. (Figure 15)

FIGURE 15

15. Write down your measurements on the service log and compare your measurements with the wear limits from the service manual.

    a. If the cylinder is within wear limits, and inspection indicated no damage, the cylinder is okay.

    b. If the cylinder exceeds wear limits, or inspection indicated damage, the cylinder should be rebored and fitted with an oversized piston.

    (NOTE: Remember in top-end service to always inspect the cylinder first because if it has to be rebored there is no point in wasting valuable time checking the piston or rings.)

16. Inspect other parts with the following procedure:

    a. Look for cracks or nicks in the cylinder head.

    b. Look for gouges, breaks, or hairline cracks in the piston. (Figure 16)

    (NOTE: Hairline cracks are easier to find by looking inside the piston.)

FIGURE 16

JOB SHEET #1

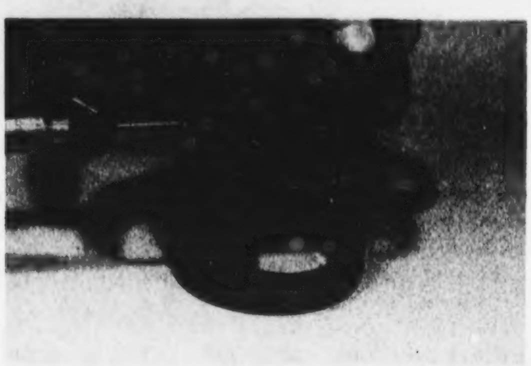
c. Look for damage in the ring grooves and lands.

d. Look for gouges, breaks, or hairline cracks in the cylinder.

17. Write down on your service log the piston wear limits as listed in the service manual.

18. Measure the piston with a micrometer and write down your measurements on the service log. (Figure 17)

FIGURE 17



19. Compare your measurement with the wear limits from the service manual.

a. If the piston is within wear limits, and inspection indicated no damage, the piston is okay.

b. If the piston exceeds the wear limits or if inspection indicated damage, the piston should be replaced.

20. Inspect the piston rings with the following procedure:

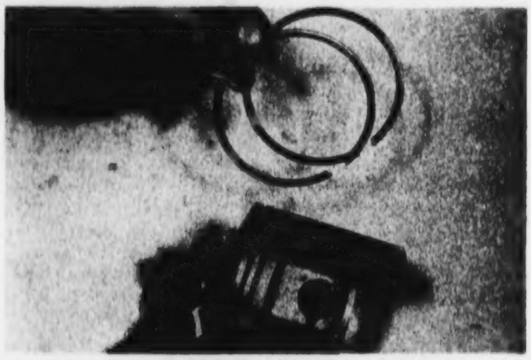
a. Look at the tip ends of the ring(s) to make sure they have not broken off. (Figure 18)

FIGURE 18

JOB SHEET #1

b. Spread the ends of the ring(s) and remove it from the piston carefully because rings break easily. (Figure 19)

FIGURE 19

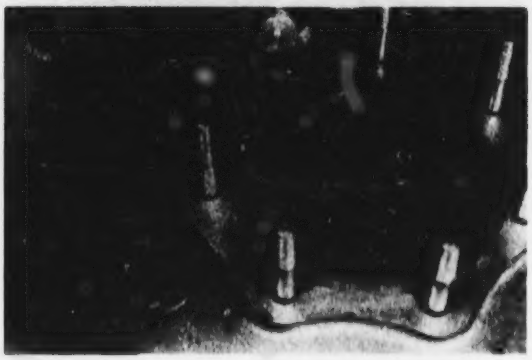


c. Install the ring(s) in the cylinder the same way it would normally fit if it were on the piston. (Figure 20)

FIGURE 20

d. Measure the end-gap between the ends of the ring with a feeler gauge and write down your measurement on your service log. (Figure 21)

FIGURE 21



JOB SHEET #1

21. Check the ring end-gap wear limits as listed in the service manual, record them on the log, and compare them with your measurements.

    a. If the end-gap is within wear limits, it is okay.

    b. If the ring end-gap exceeds wear limits, it should be replaced.

22. Check the piston pin for wear with the following procedure:

    a. Measure the pin at both ends and in the middle with a micrometer and write down your measurements on your service log. (Figure 22)

FIGURE 22

    b. Check the piston pin wear limits listed in the service manual, write them down, and compare with your measurements.

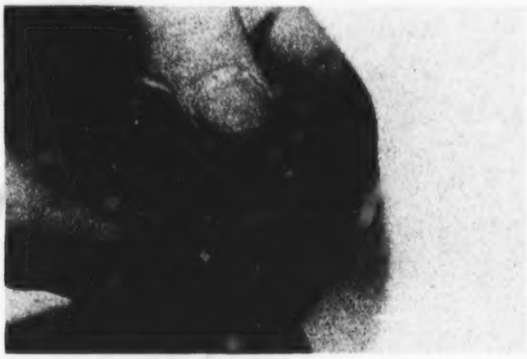
    c. If the piston pin is within wear limits, it is okay.

    d. If the piston pin exceeds wear limits, it should be replaced.

23. Check the piston pin bearing with the following procedure:

    a. Visually inspect the bearing cage for cracks or damage. (Figure 23)

FIGURE 23



JOB SHEET #1

b. If the cage appears to be okay, put it back in the small end of the rod. (Figure 24)

FIGURE 24

c. If the piston pin can still be used, put it back in the small end of the rod.

d. Check the piston pin bearing to make sure it turns freely but has no play. (Figure 25)

FIGURE 25

e. If inspection proved the piston pin bore to be okay, and the piston pin is okay, and you can't move the piston pin up and down, the piston pin bearing is okay.

f. If there is any play at all, replace the piston pin bearing.

☐ Have your instructor check your work to this point.

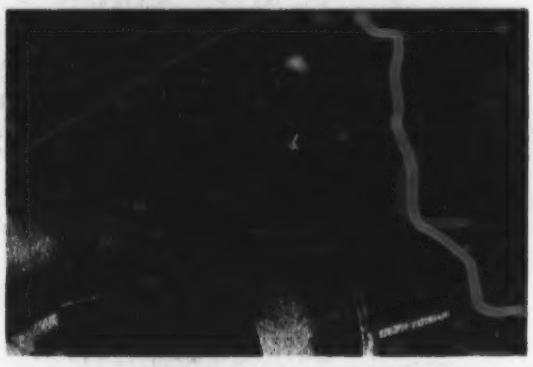
D. Routine #3 — Reassembling top-end components

1. Leave your safety glasses on.

JOB SHEET #1

2. Check all mating surfaces where gaskets were removed to make sure they are clean and in good condition. (Figure 26)

FIGURE 26



3. Check to make certain all dowel pins are in their correct locations.

4. Look down into the crankcase to make sure no foreign matter has fallen into it. (Figure 27)

FIGURE 27

5. Wash all parts with a mixture of hot water and mild dish washing detergent.

   (NOTE: Solvent is sometimes used to clean parts, but soap and water actually does a better job, especially on the cylinder because particles left from honing will literally float to the cylinder surface for easy wiping away.)

6. Rinse the parts in clean, cold water.

7. Dry the parts with compressed air.

8. Lubricate all parts immediately.

JOB SHEET #1

9. Install a new base gasket, and make sure it fits cleanly over the dowel pins and is in perfect alignment. (Figure 28)

FIGURE 28

10. Install a new ring (or rings) on the piston, and make sure it fits properly over the locator pins. (Figure 29)

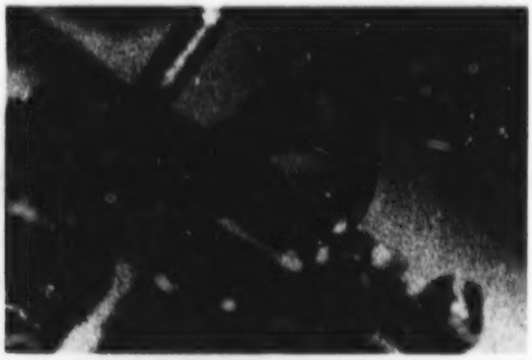
(NOTE: Be sure the ring is positioned with the top at the top and the bottom on bottom, and if there are two rings, one ring will be a top ring and the other a bottom ring, so keep them in proper order.)

FIGURE 29

JOB SHEET #1

11. Install the piston pin bearing in the small end of the connecting rod. (Figure 30)

FIGURE 30



12. Install one of the piston pin clips. (Figure 31)

FIGURE 31

13. Place the piston in position and install the piston pin and the other piston pin clip. (Figure 32)

FIGURE 32

JOB SHEET #1

14. Check both piston pin clips to make sure they are properly seated in their grooves.

15. Lubricate lightly the piston and rings. (Figure 33)

FIGURE 33

16. Squirt a couple of shots of oil down onto the big end of the connecting rod and the main bearings. (Figure 34)

(NOTE: This insures adequate lubrication for first starting the engine after top-end overhaul.)

FIGURE 34

JOB SHEET #1

17. Compress the ring onto the piston and then put the cylinder down over the piston. (Figure 35)

    (CAUTION: Do not rotate the cylinder to try to work it down onto the piston because it may cause the ring to snag on a port and break, so be certain to align the piston and cylinder perfectly as you start.)

FIGURE 35

18. Lower the cylinder down over the dowels and studs onto the crankcase and make sure it seats properly. (Figure 36)

    (NOTE: Check to make sure there are no wires or brackets interferring with proper seating of the cylinder.)

FIGURE 36

19. Install the cylinder base nuts so they are snug but not tight.

20. Check the service manual for the sequence and amount of torque, and then torque the base nuts as specified.

21. Turn the crankshaft to check for free piston movement.

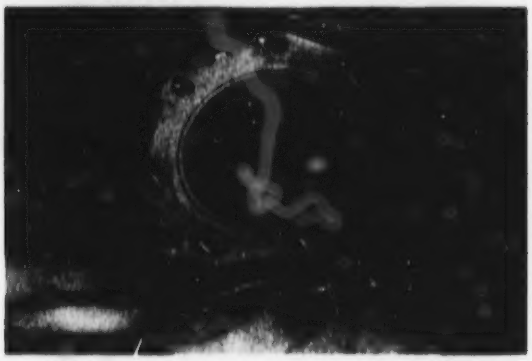
22. Wipe off excess oil from the top of the cylinder.

JOB SHEET #1

23. Inspect the gasket surfaces on the top of the cylinder and on the cylinder head to make sure they are clean and in good shape.

24. Install a cylinder head gasket. (Figure 37)

FIGURE 37



25. Install the cylinder head and make certain it is properly seated.

26. Replace the cylinder head nuts or bolts (and washers), and make them snug but not tight.

27. Check the service manual for the sequence and amount of torque, and then torque the nuts or bolts to specifications.

28. Install a new spark plug.

29. Reinstall the spark plug wire.

30. Reinstall the exhaust.

31. Reinstall the carburetor.

32. Reinstall the gas tank and hook up the gas line.

33. Reconnect the negative battery cable.

34. Wipe off any excess oil from engine, frame, and exhaust.

35. Make the following checks before you attempt to start the engine:

    a. Check throttle operation to make sure it doesn't bind or stick.

    b. Turn the engine over to make sure it turns freely.

JOB SHEET #1

36. Attempt to start the motorcycle only if your instructor tells you to do so.

☐ Have your instructor check your work.

37. Clean up area and return tools and materials to proper storage.

JOB SHEET #1

Top-End Service Log

1. Results of connecting rod inspection ____________________

2. Cylinder wear limits from service manual:

3. Your cylinder measurements:

	at 90°	in-line
Top		
Middle		
Bottom		
Top		
Middle		
Bottom		

4. Piston wear limits from service manual ____________________

5. Your piston wear measurements ____________________

6. Ring end-gap wear limits from service manual ____________________

7. Your ring end-gap measurements ____________________

8. Piston pin wear limits from service manual:

9. Your piston pin measurements:

Left	Middle	Right

10. Torque required for cylinder base (bolts) nuts ____________________

11. Torque required for cylinder head (bolts) nuts ____________________

Your name ______________________________ Date ____________

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

JOB SHEET #2 — DISASSEMBLE, INSPECT, AND REASSEMBLE A FOUR-STROKE MOTORCYCLE ENGINE

A. Tools and materials

1. Motorcycle as selected by instructor
2. Appropriate service manual
3. Basic hand tools
4. Clean shop towels
5. Solvent cleaning tank or station
6. Mild dishwashing detergent
7. Compressed air supply
8. Piston pin removing tool
9. Outside and inside micrometers
10. Gasket scraper or putty knife
11. Glass bead cleaner
12. Cylinder hone (fine-grit glaze breaker)
13. Dial bore gauge or telescoping gauge
14. Feeler gauge set
15. Squirt-type oil can and lubricant
16. Can of bearing grease
17. Torque wrench
18. Small hole gauge set
19. Ring compressor
20. Prussian Blue dye
21. Valve lap stick or piece of rubber hose

JOB SHEET #2

22. Valve grinding compound

23. New piston pin clips, spark plug, rings, gaskets, and valve guide seals

24. Pencil and Top-End Service Log

25. Safety glasses

B. Routine #1 — Preparing the motorcycle for top-end service

1. Put on your safety glasses.

2. Check the area to make sure it is free of fire hazards, and make sure there is a fire extinguisher nearby.

3. Place the motorcycle on a lift or otherwise secure it for safe engine removal.

   (NOTE: Two-stroke engines usually don't have to be removed from the bike, but four-stroke engines almost always require removal.)

4. Disconnect the battery ground cable and secure it.

5. Turn the fuel valve off and disconnect the fuel line from the carburetor.

6. Remove the fuel tank and set it in a protected area where it cannot fall.

7. Use compressed air or a high pressure washer to clean all dirt, road grime, and mud from the frame around the engine and especially above the engine.

   (NOTE: Some four-strokes are accessible for top-end overhaul without being removed from the bike, so the frame needs a good cleaning.)

8. Drain the engine oil.

9. Reinstall the oil drain plug, and tighten it to specifications.

10. Remove the carburetor and secure it in a safe position on the bike.

11. Remove the exhaust pipe.

12. Remove the drive chain cover, if necessary, and the drive chain.

13. Remove the skid plate if necessary.

JOB SHEET #2

14. Disconnect all wires leading to or from the engine, and make a sketch of where all wires come from so you can reconnect them properly. (Figure 1)

FIGURE 1

15. Remove cables as necessary.

16. Remove the engine-attaching bolts and mounting brackets, and support the engine as needed to keep it from falling as the bolts come out.

    (NOTE: You may have to jiggle the engine a bit to get the bolts out.)

17. Select a clean work area to place the engine before you pick the engine up.

18. Place the engine on the selected engine stand or workbench and make sure it is stable and sitting in such a position that it can be worked on. (Figure 2)

FIGURE 2

☐ Have your instructor check your work.

C. Routine #2 — Disassemble top-end components

1. Leave your safety glasses on.

JOB SHEET #2

2. Begin disassembly with one of the following procedures:

   a. If you are working on a model that has the ignition attached to the cylinder head, remove the ignition and set it safely aside. (Figure 3)

FIGURE 3

   b. Remove the cam sprocket cover. (Figure 4)

FIGURE 4

   c. Remove the cam sprocket bolt(s). (Figure 5)

FIGURE 5

JOB SHEET #2

d. Remove the cam sprocket from the cam so you can remove the chain.

(NOTE: The cam chain tensioner may have to be removed.)

e. If removing the cam sprocket doesn't work, remove the cam shaft from the sprocket and pull out of the engine, and this will permit chain removal.

f. Check the service manual for directions for getting the chain disconnected.

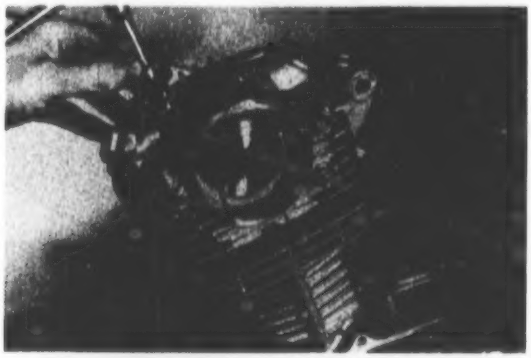
g. Remove the chain.

3. Disconnect the cam chain tensioner blade bolt, and consult the service manual if you need to. (Figure 6)

FIGURE 6

4. Remove the cylinder head bolts or nuts, and if there are two sizes of bolts or nuts, remove the smaller sizes first. (Figure 7)

FIGURE 7



5. Remove the cylinder head with the following precautions:

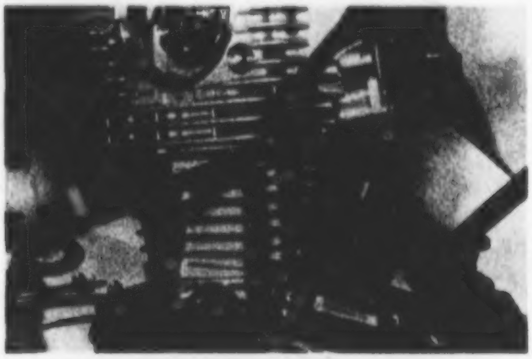
a. Do not pry in such a way that you will break the cooling fins if it is an air-cooled engine.

JOB SHEET #2

b. Be very careful not to damage the gasket surfaces.

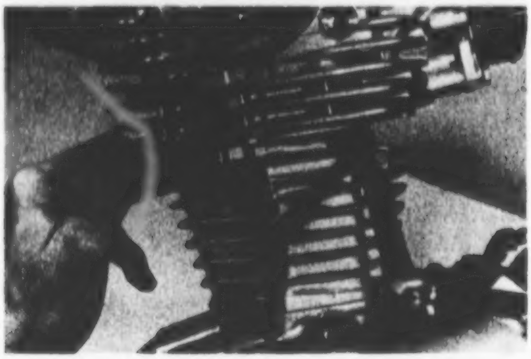
c. Use only a soft-faced mallet if you have to strike the cylinder head to get it loose, or a long-blade screwdriver to gently pry. (Figure 8)

FIGURE 8



d. Be careful that the whole cylinder doesn't loosen at the crankcase. (Figure 9)

FIGURE 9



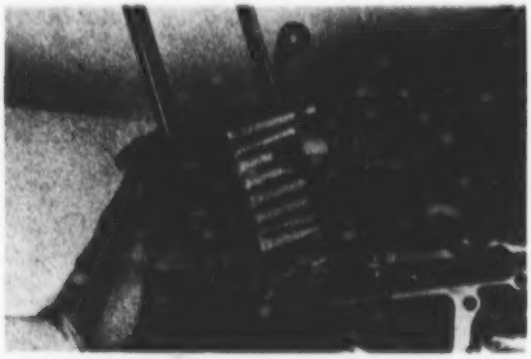
6. Remove the cylinder head and lay it aside for later inspection.

JOB SHEET #2

7. Loosen the cylinder from the crankcase with the following precautions:

   a. Try to work the cylinder loose by hand first. (Figure 10)

   FIGURE 10



   b. If the cylinder appears to be stuck, look around the base of the cylinder for indentations where a pry bar can be inserted.

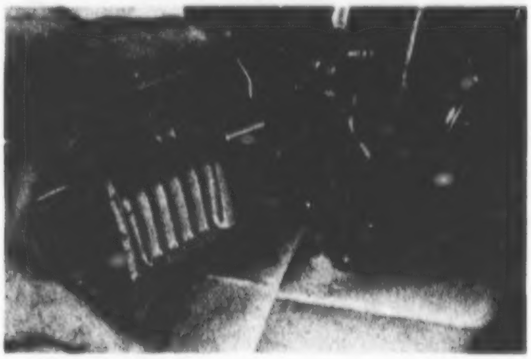
   c. If there are no indentations, a putty knife can be driven into the gasket seam with a hammer.

   d. Tapping with a soft-faced mallet will sometimes do the trick, but you have to tap at the top of the cylinder and strike straight into the cylinder to avoid breaking a cooling fin.

8. Turn engine on its side and remove the cylinder and lay it aside for later inspection. (Figure 11)

   (NOTE: Turning the engine on its side avoids the possibility that pieces of broken rings may fall down into the crankcase.)

   FIGURE 11



JOB SHEET #2

9. Place a shop towel underneath the piston to make sure the clips don't fall into the crankcase. (Figure 12)

   (NOTE: Piston pin clips should be discarded and new clips only used for reassembly, but check with your instructor before discarding the clips.)

FIGURE 12

10. Remove the piston pin clips. (Figure 13)

FIGURE 13

JOB SHEET #2

11. Use a punch to push the piston pin out if it will slide out freely. (Figure 14)

    (CAUTION: Do not hammer on the punch if the pin will not slide out freely.)

    FIGURE 14

12. Use a piston pin removing tool to safely remove a stubborn piston pin.

13. Lay the piston and pin aside for later inspection.

☐ Have your instructor check your work.

D. Routine #3 — Inspecting the cylinder, piston, and connecting rod

1. Leave your safety glasses on.

2. Check the service manual for connecting rod wear limits and write the figures down on the top-end service log that accompanies this job sheet.

3. Measure connecting rod side clearances with a feeler gauge and write your measurements down on the service log that accompanies this job sheet. (Figure 15)

    FIGURE 15

JOB SHEET #2

4. Compare your measurements with the wear limits from the service manual.

   a. If the connecting rod side clearances are within wear limits, the connecting rod is okay.

   b. If the connecting rod side clearances exceed wear limits, the connecting rod is bad and the engine will require a major overhaul.

   (NOTE: Check with your instructor if the connecting rod is bad.)

5. Check the service manual for piston pin bore wear limits and write the figures down on the service log.

6. Measure the piston pin bore with a telescoping gauge and a micrometer and write your measurement down. (Figure 16)

FIGURE 16

7. Compare your measurements with the wear limits from the service manual.

   a. If the piston pin bore is within wear limits, it is okay.

   b. If the piston pin bore exceeds wear limits, it is bad and the engine will require a major overhaul.

   (NOTE: Always check the connecting rod and piston pin bore first because if either are beyond wear limits the engine will require major overhaul, but continue with this job sheet unless directed otherwise.)

JOB SHEET #2

8. Remove all the old gaskets and O-rings with a gasket scraper or a putty knife, and make sure you don't damage the mating surface or your hand. (Figure 17)

   (CAUTION: Make sure that pieces of gasket do not fall down into the crankcase, and do not use a glass bead cleaner because you could easily damage the mating surfaces.)

   FIGURE 17

9. Clean the cylinder and piston with cleaning solvent and dry with compressed air.

10. Complete the following visual inspection first:

    a. Look for gouges, breaks, or hairline cracks in the piston. (Figure 18)

       (NOTE: Hairline cracks are easier to find by looking inside the piston.)

       FIGURE 18

JOB SHEET #2

b. Look for damage in the ring grooves and lands. (Figure 19)

FIGURE 19

c. Look for gouges, breaks, or hairline cracks in the cylinder.

  1) If the cylinder has gouges, breaks, or hairline cracks, it will have to be rebored or replaced so there's no need for any further work on the cylinder or piston.

  2) If the cylinder appears to be okay, continue with cylinder inspection. (Figure 20)

FIGURE 20

11. Inspect the cylinder with the following procedure:

  a. Write down the cylinder wear limits from the service manual on your service log.

JOB SHEET #2

b. Use a dial bore gauge, telescoping gauge, or inside micrometer to measure the cylinder in six places:

   1) At the top, middle, and bottom at 90° angles from the crankshaft. (Figure 21)

FIGURE 21

   2) At the top, middle, and bottom in line with the crankshaft. (Figure 22)

FIGURE 22

c. Write down and compare your measurements with the wear limits from the service manual.

   1) If the cylinder is within wear limits, and inspection indicated no damage, the cylinder is okay.

   2) If the cylinder exceeds wear limits, or inspection indicated damage, the cylinder should be rebored and fitted with an oversized piston.

   (NOTE: Remember in top-end service to always inspect the cylinder first because if it has to be rebored there is no point in wasting valuable time checking the piston or rings.)

JOB SHEET #2

12. Inspect the piston with the following procedures:

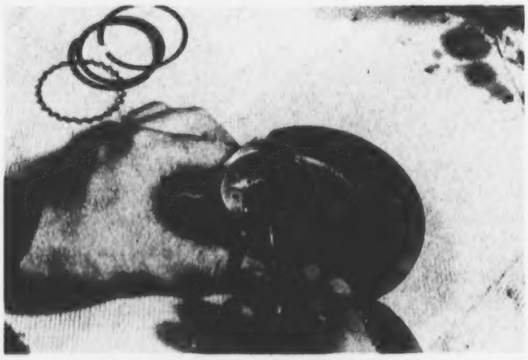
    a. Remove the piston rings by spreading them carefully with your thumbs or use a piston ring expander. (Figure 23)

    FIGURE 23

    b. Write down the piston wear limits as listed in the service manual.

    c. Measure the piston with an outside micrometer and write down your measurements on the service log. (Figure 24)

    FIGURE 24

    d. Compare your measurements with the wear limits from the service manual.

        1) If the piston is within wear limits, and visual inspection indicated no damage, the piston is okay.

        2) If the piston exceeds wear limits, or if visual inspection indicated sufficient damage, the piston should be replaced.

        (NOTE: What the preceding routine accomplishes is to find out if the piston can be used again before you spend time scraping carbon off the top of it.)

JOB SHEET #2

13. Inspect the rings with the following procedure:

    a. Spread the ends of the rings and remove them carefully because rings break easily.

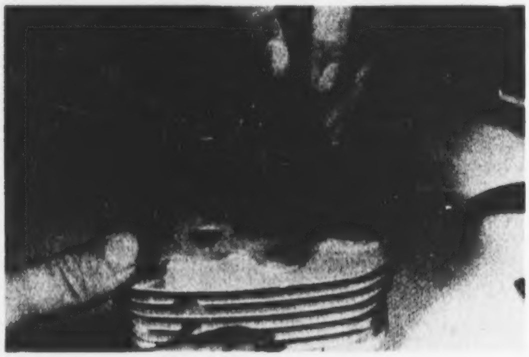
       (NOTE: There is a ring expander that can be used to remove rings, but it is used mostly for putting rings back on piston, and most technicians take rings off by hand because it saves a little time.)

    b. Install rings one at a time back into the cylinder the same way they would fit if they were on the piston.

    c. Check the service manual for ring wear limits and write the measurements down on your service log.

    d. Measure the end-gap between the ends of the ring with a feeler gauge and write your measurements on your service log. (Figure 25)

FIGURE 25



    e. Compare your measurements with the service manual wear limits.

       1) If the end-gap is within wear limits, the ring is okay.

       2) If the end-gap exceeds wear limits, the ring is bad and should be replaced.

          (NOTE: Normally, new rings are used in top-end repair, but new rings should be checked in the same manner outlined before they are installed.)

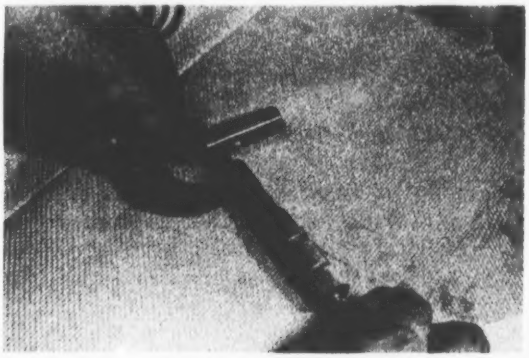
14. Inspect the piston pin with the following procedure:

    a. Check the service manual for piston pin wear limits and write the measurements on the service log.

JOB SHEET #2

b. Measure the pin at both ends and in the middle with a micrometer and write your measurements on the service log. (Figure 26)

FIGURE 26



c. Compare your measurements with the service manual wear limits.

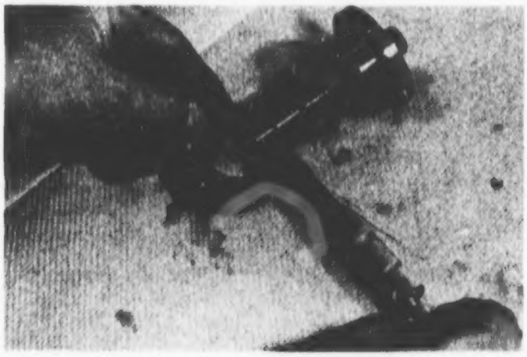
1) If the piston pin is within wear limits, it is okay.

2) If the piston pin exceeds wear limits, it should be replaced.

E. Routine #4 — Inspecting the cylinder head and camshaft

1. Leave your safety glasses on.
2. Check the service manual for wear limits of the camshaft and bearing surfaces in the cylinder head and write the measurements on the service log.
3. Check the service manual for camshaft wear limits and write the measurements on your service log.
4. Measure the camshaft OD with a micrometer and write the measurement down. (Figure 27)

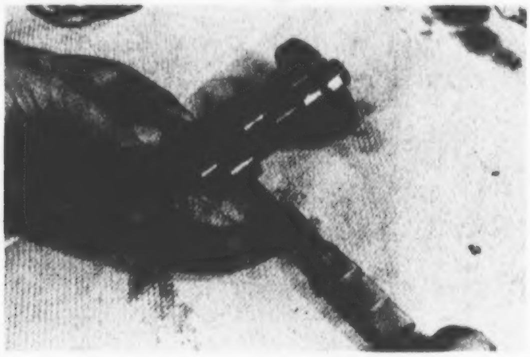
FIGURE 27



JOB SHEET #2

5. Measure each cam lobe height with a micrometer and write the measurment down. (Figure 28)

FIGURE 28



6. Inspect the camshaft and lobes visually for wear or damage.

7. Measure the inside diameter of the camshaft bearings in the cylinder head and write the measurements on the log. (Figure 29)

FIGURE 29

8. Subtract the outside diameter of the camshaft from the inside diameter of the camshaft bearing, and write down the difference.

9. Check the service manual to see how much oil clearance is required and compare that with your figure.

   a. If all clearances are within service limits, the camshaft and cylinder head are okay.

   b. If clearances exceed service limits, the camshaft or cylinder head, or both, should be replaced.

JOB SHEET #2

10. Inspect the rocker arms for damage, wear, or clogged oil holes, and if you find any problems, go back and check the camshaft lobes again. (Figure 30)

FIGURE 30

11. Check the service manual for the wear limits of the rocker arm shaft holes and write the measurements down.

12. Remove the rocker arms and measure the ID of each rocker arm shaft hole with a small telescoping gauge and a micrometer and write your measurements on your service log. (Figure 31)

FIGURE 31

13. Compare your measurements with the wear limits from the service manual.

    a. If the rocker arm shaft holes are within wear limits, the rocker arms are okay.

    b. If the rocker arm shaft holes exceed wear limits, replace them.

14. Check the service manual for the wear limits of the rocker arm shafts, and write down the OD measurements of the shaft on the log.

JOB SHEET #2

15. Measure the rocker arm shafts on both ends and in the middle and write your measurements on the log. (Figure 32)

FIGURE 32

16. Subtract the shaft OD measurement from the rocker arm ID measurement you made earlier, and write the difference down.

    a. This measurement is the oil clearance.

    b. If the clearance is within wear limits, the rocker arms and the shafts are okay.

    c. If the clearance is not within wear limits, the shafts or both the shafts and rocker arms will have to be replaced.

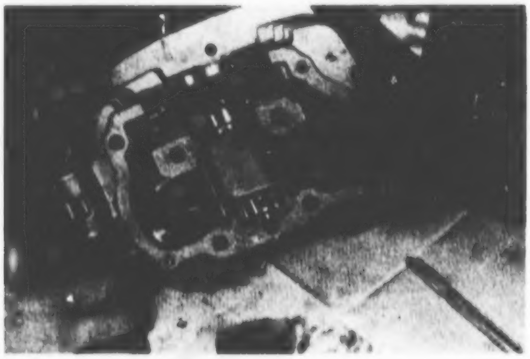
☐ Have your instructor check your work.

F. Routine #5 — Disassembling and inspecting the cylinder head

1. Leave your safety glasses on.

2. Remove the valve cotters, spring retainers, and valve springs with a valve spring compressor. (Figure 33)

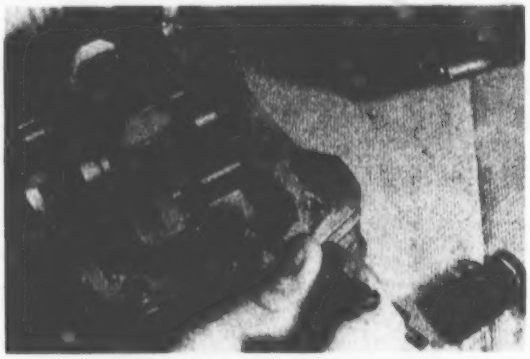
FIGURE 33



JOB SHEET #2

3. Remove the washers that sit directly underneath the valve springs. (Figure 34)

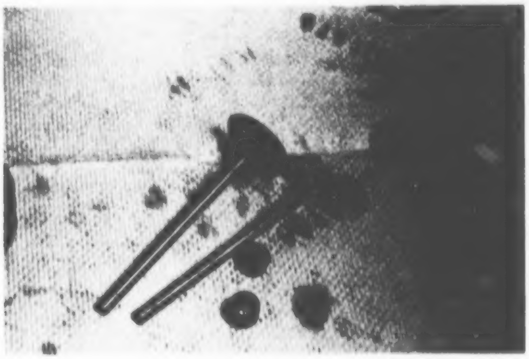
FIGURE 34



4. Remove the valves from the cylinder head and then remove the valve stem seals. (Figure 35)

   (NOTE: If the cotters have grooved the valve stems, remove the grooves with a flat file so the valves will come out easier.)

FIGURE 35



JOB SHEET #2

5. Remove carbon deposits from the combustion chamber with a putty knife or pocket knife. (Figure 36)

FIGURE 36

6. Clean off any gasket material from the cylinder head mating surface, and remember not to use a glass bead cleaner because there are ports and other surfaces that glass bead residue cannot be removed from. (Figure 37)

FIGURE 37

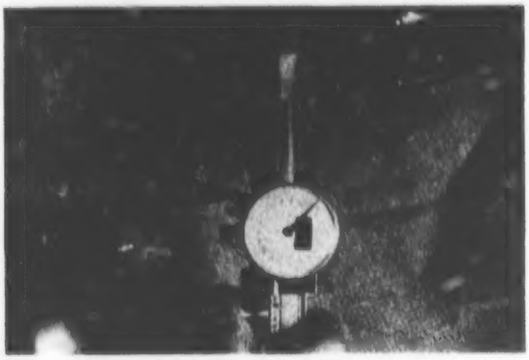
7. Check the spark plug hole in valve area for cracks.

8. Check the service manual for the free-length valve spring wear limits and write the measurements for the inner and outer springs on the service log.

JOB SHEET #2

9. Measure the free-length valve springs and write your measurements on your service log. (Figure 38)

FIGURE 38



   a. If the valve springs free-length are within wear limits, they are okay.

   b. If the valve springs free-length exceed wear limits, replace them.

10. Check the service manual for valve stem and valve guide wear limits and write the measurements on your service log.

11. Inspect each valve visually for trueness, burning, scratches, or pitting. (Figure 39)

FIGURE 39

JOB SHEET #2

12. Make a careful check of the valve face that contacts the valve seat because this is the surface where wear most often occurs that requires valve replacement. (Figure 40)

FIGURE 40

13. Measure the valve stem with a micrometer in the middle and at the end and write your measurements on the service log. (Figure 41)

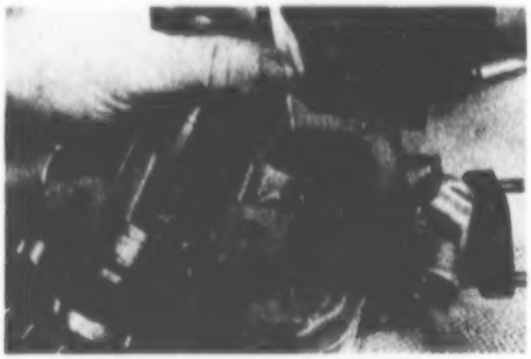
FIGURE 41

14. Compare your valve stem measurements with the wear limits from the service manual.

JOB SHEET #2

15. Measure the valve guides with a small hole gauge and a micrometer and write your measurements on the log. (Figure 42)

FIGURE 42



a. If the valves are okay and the valve stems are within wear limits, and the valve guides are within wear limits, the valves are okay.

b. If the valves are okay and the valve guides are okay, but the valve stems exceed wear limits, replace the valves.

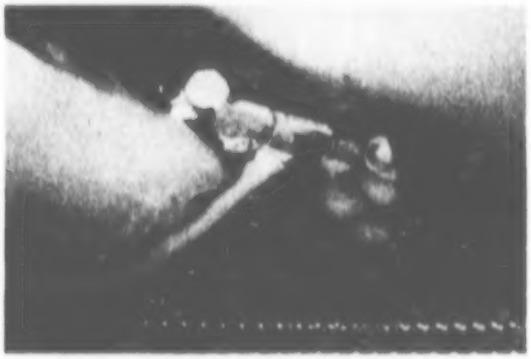
c. If the valves are okay and the valve stems are okay, but the valve guides are bad, replace the valve guides.

(NOTE: Replacing valve guides is considered a part of major overhaul, so if your inspection shows bad valve guides, check with your instructor.)

16. Use a glass bead cleaner or a wire wheel on a grinder to clean carbon deposits from all intake and exhaust valves. (Figure 43)

(CAUTION: If you use a wire wheel and a bench grinder, secure the valve and support it properly so that the wheel won't jerk it out of your hand.)

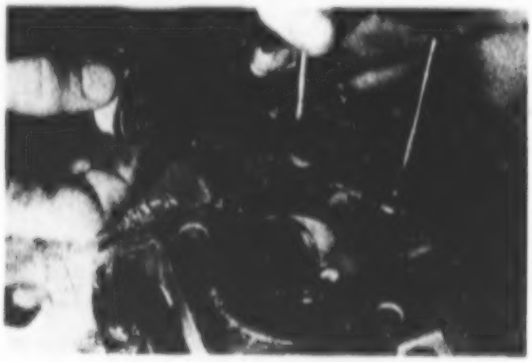
FIGURE 43



JOB SHEET #2

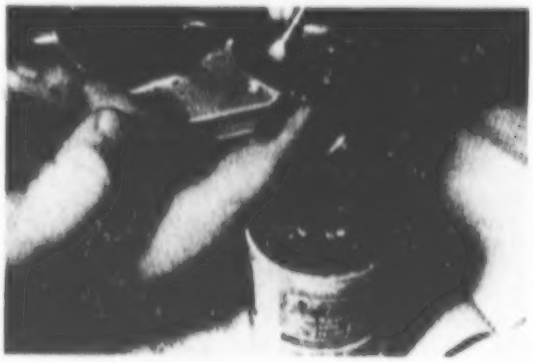
17. Apply a light coating of Prussian Blue dye to each valve face and valve seat, and allow the dye to dry. (Figure 44)

FIGURE 44



18. Apply a light coating of valve grinding compound to the face of each valve. (Figure 45)

FIGURE 45



19. Reinstall the valves in the cylinder head.

JOB SHEET #2

20. Use a valve lap stick on the valve stem and rotate the valve on its seat several times. (Figure 46)

FIGURE 46

21. Remove the valves and wipe the valves and valve seats free of grinding compound. (Figure 47)

(NOTE: It is vital that all grinding compound be removed because it is an extremely harsh abrasive that could damage an engine if it were left on the valves and seats.)

FIGURE 47

JOB SHEET #2

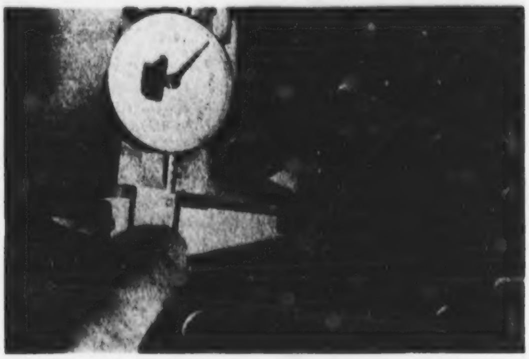
22. Inspect carefully the patterns left on the faces of the valves, and if the patterns show evidence of pitting or uneven contact, the valves must be replaced. (Figure 48)

FIGURE 48

23. Check the service manual for valve seat width wear limits and write the measurements on the log.

24. Measure with a dial caliper the width of the pattern left by grinding, and write your measurements on the log. (Figure 49)

FIGURE 49



    a. This will give you the width of the valve seat face.

    b. If the valve seat widths are within wear limits, the valve seats are okay.

    c. If the valve seat widths exceed wear limits, the valve seats must be recut.

JOB SHEET #2

25. Inspect the valve seats visually for uneven contact pattern or pitting, and if either condition is present, the valve seats have to be recut. (Figure 50)

FIGURE 50

26. Make a recommendation as to whether or not the valve seats need to be recut, and enter your recommendation on the top-end service log that accompanies this job sheet.

☐ Have your instructor check your work.

(NOTE: If the valve seats require recutting, this is considered a major overhaul item, so ask your instructor for instructions; however, continue with this job sheet.)

G. Routine #6 — Cleaning and reassembling the engine

1. Leave your safety glasses on.
2. Inspect all mating surfaces to be sure they are clean and free of imperfections.
3. Hone the cylinder lightly with a fine grit glaze-breaking hone.

   (NOTE: If you're not putting in new rings, the cylinder should not be honed.)
4. Wash the cylinder with hot water and a mild dishwashing detergent.
5. Dry the cylinder with compressed air and oil immediately.
6. Check to make certain all dowel pins are in their correct locations.
7. Look down into the crankcase to make sure no foreign matter has fallen into it.
8. Wash all parts with hot water and a mild dishwashing detergent.
9. Rinse the parts in clean, cold water.

JOB SHEET #2

10. Clean the parts with compressed air.

11. Lubricate all but aluminum parts immediately.

12. Reassemble the cylinder head.

13. Install the valves.

14. Reinstall the washers that go underneath the valve springs. (Figure 51)

FIGURE 51

15. Install new valve stem seals. (Figure 52)

FIGURE 52

JOB SHEET #2

16. Install the valve springs, and make certain that the close-wound end of the springs are toward the cylinder head. (Figure 53)

FIGURE 53

17. Use a valve spring compressor to compress the springs, and reinstall the valve cotters with the following procedure:

    a. Dip a long, thin-blade screwdriver into a can of heavy, wheel bearing grease.

    b. Stick the cotter to the tip of the screwdriver so that it is well stuck in the grease.

    c. Put some grease on a finger and grease the inside of the cotter.

    d. Install the cotter on the valve stem, making sure the cotter is in its exact location. (Figure 54)

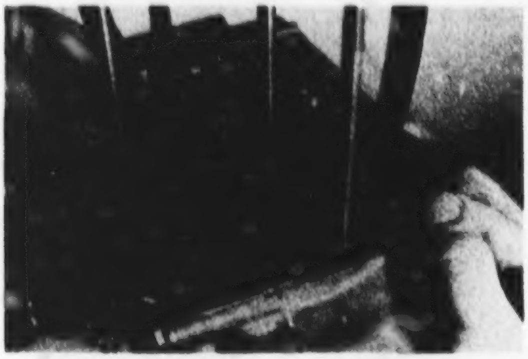
    FIGURE 54

    e. Repeat the operation for all cotters as required.

JOB SHEET #2

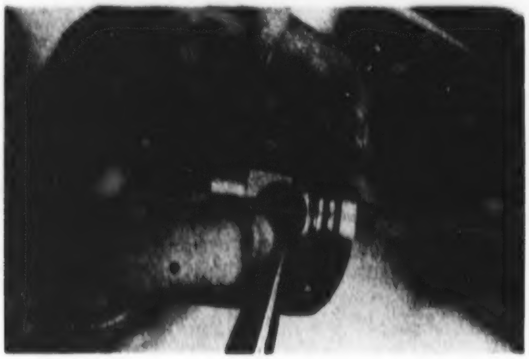
18. Install a new base gasket and make sure it fits over the dowel pins so it will be properly aligned. (Figure 55)

FIGURE 55



19. Install one of the new piston pin clips in the piston. (Figure 56)

FIGURE 56



JOB SHEET #2

20. Install the rings in their correct locations, and space the end-gaps evenly around the piston so that the end-gaps are not lined up. (Figure 57)

    (NOTE: Be sure the top ring is on top, the center ring in the center, and the bottom ring in the bottom, and also be certain that the rings are installed right side up.)

FIGURE 57

21. Lubricate the piston and rings lightly with engine oil.

22. Install the piston on the connecting rod, making certain that it faces the right direction.

    (NOTE: Remember IN means intake and should go toward the intake side of the engine, and EX means exhaust and should go toward the exhaust side of the engine, and in case there are no markings, the largest valve relief on the piston goes toward the intake.)

23. Lubricate the piston pin lightly and install the pin. (Figure 58)

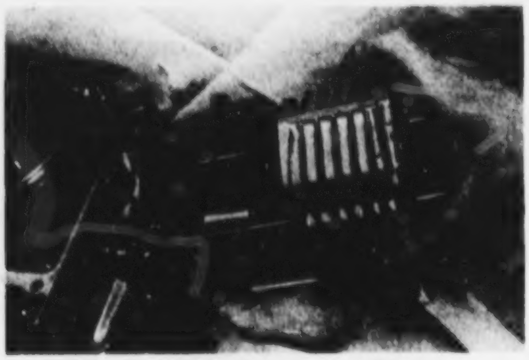
FIGURE 58

JOB SHEET #2

24. Put the other new piston clip in place, and make sure both clips are snug in their grooves.

25. Use a piston ring compressor or hand guide the rings and install the cylinder onto the piston. (Figure 59)

FIGURE 59



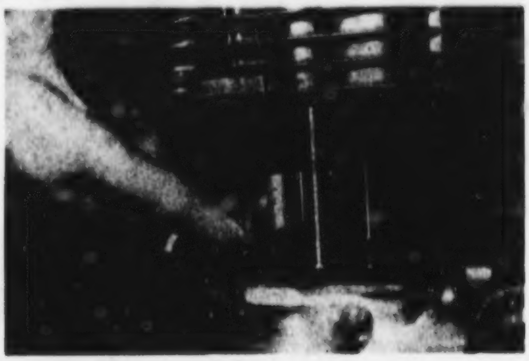
26. Remove the piston ring compressor.

27. Check your service manual for the proper sequence required to reinstall the cylinder head and time the cam.

28. Push the cylinder down over the dowels and studs and make sure it seats properly. (Figure 60)

(NOTE: Check to make sure there are no brackets or wires to interfere with the seating of the cylinder.)

FIGURE 60



29. Install nuts or bolts as required, and make sure they are snug but not tight.

JOB SHEET #2

30. Install cam chain guides or tensioners if the engine is so equipped.

31. Wipe off excess oil from the top of the cylinder.

32. Install a new cylinder head gasket and new O-rings as required.

33. Install the cylinder head and if there is one, the cylinder head cover. (Figure 61)

(NOTE: Some Honda enignes require a sealer instead of a gasket on the cylinder head cover.)

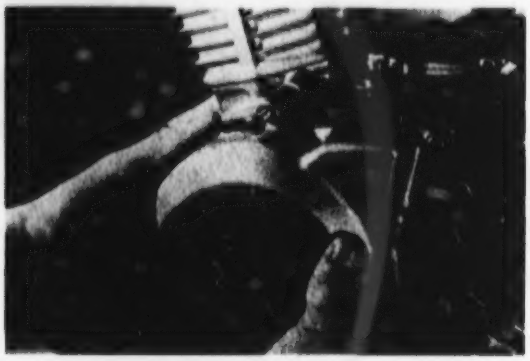
FIGURE 61

34. Check the cylinder and cylinder head torque specifications and tightening sequence as outlined in the service manual, and write the information on your log.

35. Install the nuts or bolts on the cylinder head and torque to specifications in the proper sequence.

36. Install the flywheel cover. (Figure 62)

FIGURE 62



JOB SHEET #2

37. Install and time the cam shaft according to procedures in the appropriate service manual.

38. Reinstall the ignition, if engine is so equipped, and time the ignition.

39. Adjust valves.

☐ Have your instructor check your work.

H. Routine #7 — Reinstalling the engine in the motorcycle

1. Leave your safety glasses on.

2. Make sure the motorcycle is securely supported so that it won't fall.

3. Check to make sure there are no cables or wires that will interfere with reinstallation of the engine.

4. Place all necessary bolts, nuts, washers, and brackets in a place where you can conveniently reach them.

   (NOTE: Since the engine has to be held while the bolts are installed, having them handy is not only a time saver, your buddy left holding the engine up while you hunt for bolts and nuts might not be a buddy much longer.)

5. Install the engine.

6. Check once again to make sure no cables or wires are caught between the engine and frame.

7. Check service manual for torque specifications on the engine-mounting bolts and write the information down.

8. Torque all engine-mounting bolts to specifications, and in sequence if there is a sequence.

9. Reconnect all wires to and from the engine, and use the sketch you made at the time of disassembly to make sure all wires are properly replaced.

10. Reinstall all cables, and make sure they are properly routed.

11. Replace skid plate, drive chain, and drive chain cover.

12. Replace the exhaust pipe.

13. Replace the carburetor.

14. Check to make sure the oil drain plug is tight.

JOB SHEET #2

15. FILL THE ENGINE WITH THE PROPER AMOUNT OF OIL.
16. Install a new spark plug in the cylinder head.
17. Reinstall the fuel tank and hook the fuel line up to the carburetor.
18. Wipe off any excess oil from engine, frame, and exhaust.
19. Make the following checks before you attempt to start the engine:
    a. Check throttle operation to make sure it doesn't bind or stick.
    b. Turn the engine to make sure it turns freely.
20. Reconnect the negative battery cable.
21. Attempt to start the motorcycle only if your instructor tells you to do so.

☐ Have your instructor check your work.

22. Clean up area and return tools and materials to proper storage.

JOB SHEET #2

Top-End Service Log

1. Results of connecting rod inspection ____________________

2. Piston pin bore limits from service manual ____________________

3. Your piston pin bore measurements ____________________

4. Cylinder wear limits from service manual:

5. Your cylinder measurements:

	at 90°	in-line
Top		
Middle		
Bottom		
Top		
Middle		
Bottom		

6. Piston wear limits from service manual ____________________

7. Your piston wear measurements ____________________

8. Ring end-gap wear limits from service manual ____________________

9. Your ring end-gap measurements ____________________

10. Piston pin wear limits from service manual:

11. Your piston pin measurements:

Left	Middle	Right

12. Camshaft wear limits from service manual ____________________

13. Your camshaft OD measurement ____________________

14. Your measurement of cam lobe height ____________________

15. Your measurement of ID of camshaft bearings ____________________

____

16. Oil clearance requirements from service manual ____________________

JOB SHEET #2

17. Your oil clearance measurement (subtract camshaft bearing ID from camshaft OD) ____________________

18. Free-length valve spring wear limits from service manual ____________________
____

19. Your free-length valve spring measurements ____________________
____

20. Valve stem wear limits from service manual ____________________

21. Your valve stem measurements ____________________

22. Valve guide wear limits from service manual ____________________

23. Your valve guide measurements ____________________

24. Valve seat width wear limits from service manual ____________________

25. Your valve seat width measurements ____________________

26. Cylinder and cylinder head nut torque specifications and tightening sequence from service manual ____________________
____

27. Torque specifications from service manual for engine-mounting bolts ________
____

Your name ____________________ Date ____________

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

PRACTICAL TEST #1
JOB SHEET #1 — DISASSEMBLE, INSPECT, AND REASSEMBLE A TWO-STROKE MOTORCYCLE ENGINE

Student's name ______________________ **Date** __________

Evaluator's name ______________________ **Attempt no.** ______

Student instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1. Wore safety glasses.	1.	☐	☐
2. Disassembled top-end components properly.	2.	☐	☐
3. Cleaned and inspected components with care.	3.	☐	☐
4. Inspected cylinder walls and recorded wear limits.	4.	☐	☐
5. Measured cylinder with a dial bore gauge.	5.	☐	☐
6. Checked wear limits on components and measured for comparison.	6.	☐	☐
7. Made appropriate entries in service log.	7.	☐	☐
8. Reassembled top-end components properly.	8.	☐	☐
9. Installed new spark plug.	9.	☐	☐
10. Torqued all fasteners to specifications.	10.	☐	☐
11. Made appropriate checks before starting engine.	11.	☐	☐
12. Verified proper engine operation.	12.	☐	☐
13. Cleaned area and returned tools to storage.	13.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

MM-975

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

PRACTICAL TEST #2
JOB SHEET #2 — DISASSEMBLE, INSPECT, AND REASSEMBLE A FOUR-STROKE MOTORCYCLE ENGINE

Student's name ______________________________ **Date** ____________

Evaluator's name ______________________________ **Attempt no.** ______

Student Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:			YES	NO
1.	Wore safety glasses.	1.	☐	☐
2.	Prepared bike for top-end service.	2.	☐	☐
3.	Disassembled top-end components properly.	3.	☐	☐
4.	Inspected the cylinder, piston, and connecting rod.	4.	☐	☐
5.	Checked wear limits and measured all components.	5.	☐	☐
6.	Recorded measurements on service log.	6.	☐	☐
7.	Inspected the cylinder head and camshaft.	7.	☐	☐
8.	Disassembled and inspected cylinder head.	8.	☐	☐
9.	Inspected and serviced valves properly.	9.	☐	☐
10.	Cleaned and reassembled engine.	10.	☐	☐
11.	Reinstalled engine with proper procedure.	11.	☐	☐
12.	Made appropriate checks before starting engine.	12.	☐	☐
13.	Verified proper engine operation.	13.	☐	☐
14.	Cleaned area and returned tools to storage.	14.	☐	☐

Evaluator's comments: ____

____

____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

Tools and Equipment	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Materials	Properly selected and properly used 4	Properly selected and acceptably used 3	Poorly selected and/or used 2	Improperly selected and/or used 1
Procedure	Properly followed 4	Acceptably followed 3	Poorly followed 2	Improperly followed 1
Safety	Carefully observed 4	Acceptably observed 3	Poorly observed 2	Improperly observed 1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled
3 — Moderate skills
2 — Limited skills
1 — Unskilled

(EVALUATOR NOTE: If an average score is needed to complete a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

NAME ______________________

TEST

1. Match terms related to one-cylinder top-end service with their correct definitions.

_____a. A shape which tends to be more egg-shaped than round

_____b. Going in the same direction as the straight length of the crankshaft

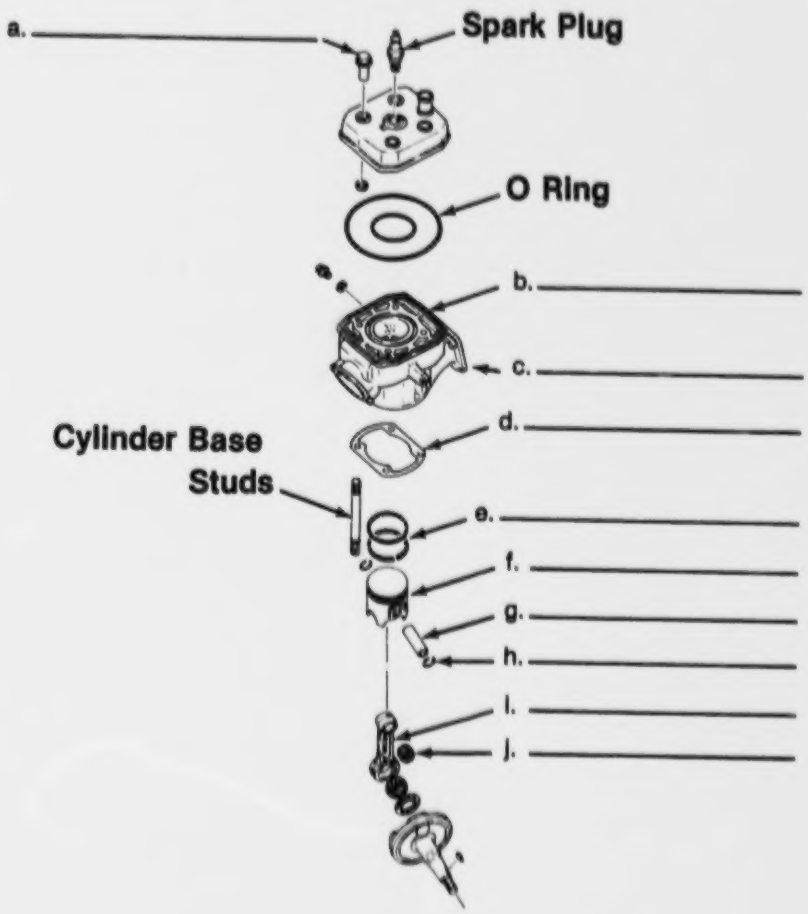
_____c. All the components in a motorcycle engine going upward from the cylinder base gasket to the cylinder head

_____d. A manufacturer's specifications for the amount of wear a part can experience and still be serviceable

1. Top end
2. Wear limits
3. Elliptical
4. In-line

TEST

2. Identify components of a two-stroke top end by placing the correct component name in the appropriate blank.


a. ______
Spark Plug
O Ring
b. ______
c. ______
d. ______
Cylinder Base Studs
e. ______
f. ______
g. ______
h. ______
i. ______
j. ______

TEST

3. Complete a list of components of a four-stroke top end by inserting the word(s) that best completes each statement.

a. Cylinder ____________ gasket

b. Cylinder base ____________ pins

c. Cylinder ____________

d. Cylinder

e. Piston ____________

f. Piston pin ____________

g. Piston

h. Piston ____________

i. Cylinder ____________ gasket

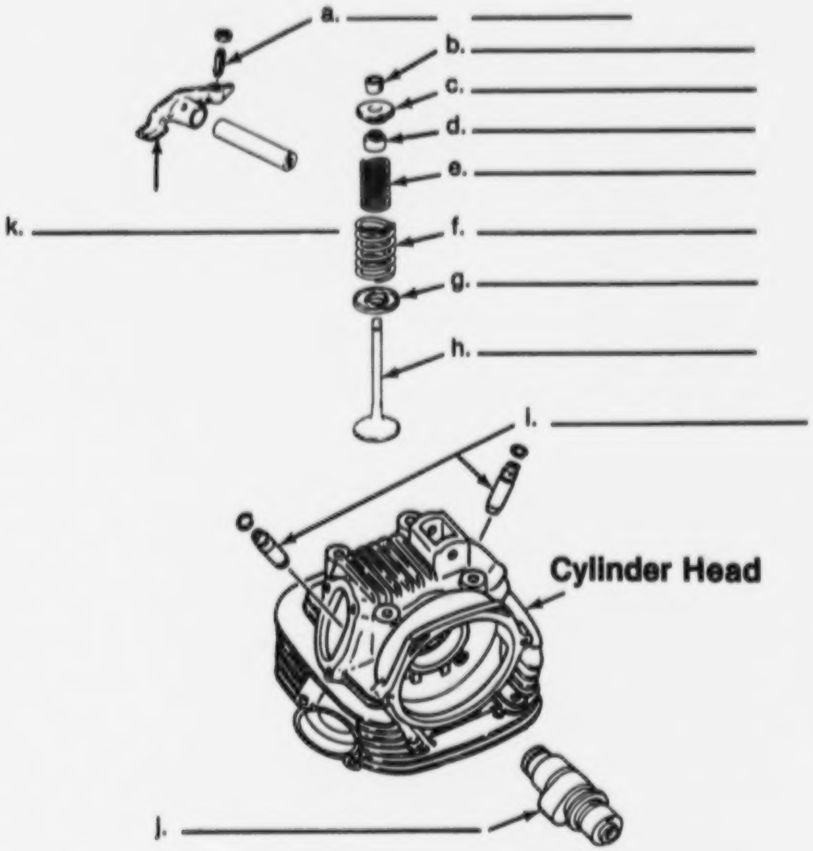
j. Cylinder head ____________ pins

k. Cylinder head

l. Cylinder head ____________ and ____________

TEST

4. Identify components of a four-stroke cylinder head by inserting the correct component name in the appropriate blank.


a. ______ ______
b. ______
c. ______
d. ______
e. ______
k. ______
f. ______
g. ______
h. ______
i. ______
Cylinder Head
j. ______

TEST

5. Complete a list of parts of a two-stroke piston by inserting the word(s) that best completes each statement.

   a. Piston ____________

   b. Piston ____________ bore

   c. Piston ____________ bosses

   d. Piston ____________ lands

   e. Piston ____________ grooves

   f. Piston ____________ locating pins

   g. ____________ of piston

   h. Piston pin clip ____________

   i. Piston pin ____________

   j. Piston ____________

   k. Piston pin ____________

6. Complete a list of parts of a four-stroke piston by inserting the word(s) that best completes each statement.

   a. Piston ____________

   b. Piston pin ____________

   c. Piston pin ____________

   d. Piston ring ____________

   e. Piston ring ____________

   f. ____________ drain holes

   g. ____________ of piston

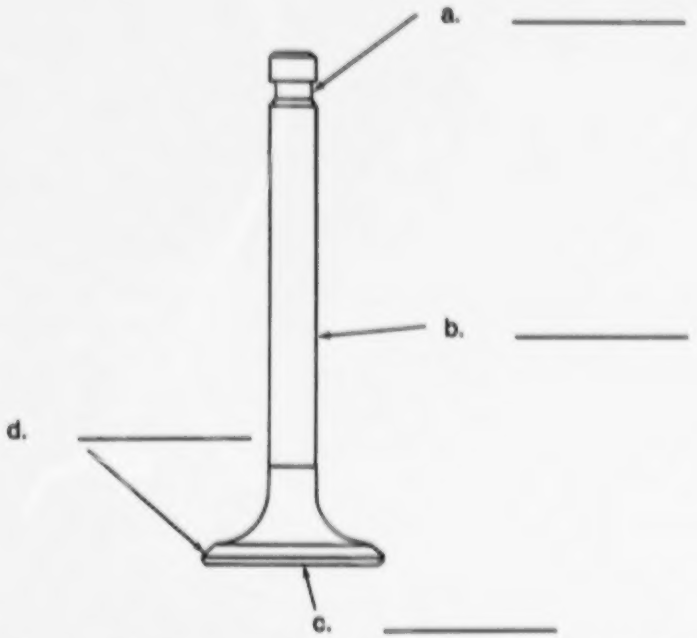
   h. Piston pin clip ____________

   i. Piston pin ____________

   j. Piston ____________

TEST

7. Identify parts of a valve by inserting the correct part name in the appropriate blank.



8. Select true statements concerning guidelines for cleaning top-end components by placing an "X" beside each statement that is true.

_____a. Cleaning pistons, cylinders, and all internal surfaces during top-end service is an absolute requirement.

_____b. Dirt, grime, grit, and cuttings that stick to oily surfaces while the engine is disassembled could cause premature engine failure after overhaul.

_____c. Although solvent is used for the majority of cleaning, it is a petroleum product and will itself become quickly contaminated.

_____d. Solvent will clean particulate matter left from glass bead cleaning or cutting and grit left after honing a cylinder.

_____e. Hot, soapy water containing a mild dishwashing detergent is an excellent cleaner because it will float away glass bead residue and cuttings and grit.

_____f. Parts washed in hot, soapy water should be rinsed in clean, cold water, dried with compressed air, but should not be oiled until time for reassembly

TEST

9. Complete statements concerning guidelines for measuring a cylinder by inserting the word(s) or figure(s) that best completes each statement.

   a. A preliminary ____________ inspection should precede any other work on the cylinder because if the inspection indicates the cylinder is too bad for service, there is no need to waste time measuring.

   b. Cylinders are measured at six different locations:

1) ____________ with the crankshaft at the top, middle, and bottom of the cylinder

2) ____________ to the crankshaft at the top, middle, and bottom of the cylinder

   c. On two-stroke engines, the middle cylinder measurement should be made as close to the ____________ as possible.

   d. A small amount of cylinder wear, both out-of-round and taper, is permissible, and these wear limits are specified in the appropriate ____________ ____________.

   e. Always make cylinder measurements ____________ inspecting a piston because if the cylinder is bad it will have to be rebored and a new piston will be required.

10. Complete statements concerning guidelines for measuring a piston by inserting the word(s) or figure(s) that best completes each statement.

   a. A preliminary ____________ inspection should precede any other work with the piston because if the inspection indicates the piston is too bad for service, there is no need to waste time measuring.

   b. If a piston were perfectly cylindrical, it would fit the cylinder only when the engine is ____________, and fit poorly when the engine is ____________.

   c. The piston head and ring groove area are ____________ for extra strength, and the piston skirt is ____________ to save weight, so the differences in thickness means a piston does not expand evenly when it heats up.

   d. Because the piston expands more across the piston pin bosses than across the skirt, a piston must be ____________ and not round.

   e. Because of the way a piston is made, it has to be measured with a micrometer across the skirt at 90° to the piston pin bosses, ____________ up from the bottom edge of the piston.

TEST

11. Select true statements concerning two-stroke piston rings by placing an "X" beside each statement that is true.

(NOTE: For a statement to be true, all parts of the statement must be true.)

______a. Two-stroke engines normally have two compression rings, and do not require an oil control ring because oil is mixed with the fuel.

______a. Two-stroke engines in racing bikes frequently have only one compression ring to cut down on friction and increase speed, but the ring wears out quickly and must be changed often.

______a. Two-stroke rings have three basic designs:

1) Oil compression type

2) Keystone

3) Dykes or L-shaped

12. Solve the following problems concerning guidelines for installing two-stroke rings.

a. You are working on a two-stroke engine and come across a set of two flat rings. One of the rings is marked N-1 and the other ring is marked N-2; which ring would you put on top?

Answer ____

b. A flat ring you are getting ready to install has a bevel on the inside of the ring; what does the bevel indicate?

Answer ____

c. You are working with a set of Keystone rings; would you expect their markings to be different from the markings on flat rings?

Answer ____

13. Solve the following problems concerning four-stroke rings.

a. What visual clue would help you recognize the top or compression ring in a set of four-stroke rings?

Answer ____

b. What two visual clues would help you recognize a combination compression/oil control ring?

Answer ____

TEST

c. If the top compression ring had a bevel on the inside of the ring, how would you install it?

Answer ______________________________

14. Complete statement concerning special tools and materials for top-end service by inserting the word(s) that best completes each statement.

a. Piston pin __________ __________ helps prevent damage not only to the piston pin but to the connecting rod and the piston itself.

b. A __________ __________ is used to put a cross-hatch finish on the cylinder walls, a finish that will cause the piston and rings to immediately wear the small amount required for proper seating.

c. A __________ __________ is used to compress the rings so that the piston can be fitted back into the cylinder without damaging the rings.

d. A valve __________ compressor is a tool used to compress valve springs so that the valve cotters can be removed.

e. __________ __________ dye is a thin but highly-resistant coating that leaves highly accented wear patterns for evaluating valve and valve seat conditions.

f. A valve __________ __________ is a suction device on a convenient wooden handle so it can be stuck to the top of a valve and used to rotate the valve back and forth.

g. A piece of small-diameter __________ __________ placed over the valve stem will accomplish the same thing as a valve lap stick.

h. Valve __________ compound is an abrasive material that is used in lapping the valve seat to the valve face.

15. Select true statements concerning ring installation by placing an "X" beside each statement that is true.

_____a. Before installing rings, always inspect the ring grooves in the piston for carbon build-up or damage.

_____b. If ring grooves need cleaning, the best thing to use is a piece of broken ring, but a glass bead cleaner is not recommended because it will damage the piston.

_____c. Install rings in proper order and with the correct side up.

_____d. On two stroke rings, be sure to place end gaps over the locating pins.

TEST

_____e. On four-stroke rings, it is important to make sure that the ends of the expander butt together and do not overlap.

_____f. A ring expander is usually used to install four-stroke rings, but is seldom used to install two-stroke rings.

16. Complete statements concerning safety guidelines for top-end service by inserting the word(s) that best completes each statement.

    a. Because piston rings are ____________ and they sometimes break into small pieces, it's good to hold rings at a safe distance from your face.

    b. Piston rings have ____________ edges that can easily cut fingers and hands.

    c. Cylinders have sharp edges that can cut fingers and hands, so be especially careful ____________ a cylinder after it has been honed.

    d. Valve spring ____________ should be worked with care to avoid letting a spring slip because it's hard to tell where the spring might hit as it flies away.

    e. Pistons have especially sharp edges on the bottom of the ____________ and should be handled with care.

    f. Never stick your fingers into open ____________ or other places where they might be exposed to danger.

    g. Piston pin ____________ are spring-pressure devices and will fly off almost anywhere if not contained as they're removed.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

17. Demonstrate the ability to:

    a. Disassemble, inspect, and reassemble a two-stroke motorcycle engine. (Job Sheet #1)

    b. Disassemble, inspect, and reassemble a four-stroke motorcycle engine. (Job Sheet #2)

ONE-CYLINDER ENGINE TOP-END SERVICE
UNIT XIX

ANSWERS TO TEST

1. a. 3
    b. 4
    c. 1
    d. 2

2. a. Cylinder head bolts
    b. Cylinder head gasket
    c. Cylinder
    d. Cylinder base gasket
    e. Piston rings
    f. Piston
    g. Piston pin
    h. Piston pin clip
    i. Connecting rod
    j. Piston pin bearing

3. a. Base
    b. Dowel
    c. Cylinder studs
    d. Pin
    e. Clips
    f. Rings
    g. Head
    h. Dowel
    i. Nuts, washers

4. a. Valve adjuster
    b. Valve cotter
    c. Valve spring retainer
    d. Valve stem seal
    e. Inner valve spring
    f. Outer valve spring
    g. Spring seat washer
    h. Valve
    i. Valve guides
    j. Camshaft
    k. Rocker arm

5. a. Skirt
    b. Pin
    c. Pin
    d. Ring
    e. Ring
    f. Ring
    g. Top
    h. Grooves
    i. Clips
    j. Pin
    k. Bearing

ANSWERS TO TEST

6. a. Skirt
   b. Bore
   c. Bosses
   d. Lands
   e. Grooves
   f. Oil
   g. Top
   h. Grooves
   i. Clips
   j. Pin

7. a. Cotter retaining groove
   b. Valve stem
   c. Valve face
   d. Valve head

8. a, b, c, e

9. a. Visual
   b. 1) In-line
      2) 90°
   c. Ports
   d. Service manual
   e. Before

10. a. Visual
    b. Cold, hot
    c. Thicker, thin
    d. Elliptical
    e. 5 mm

11. a, b

12. a. The N-1 goes on top; the N-2 on bottom
    b. The bevel always goes up
    c. No

13. a. It has a light-colored edge
    b. The dark color and a notch on the outside edge
    c. The bevel should be installed pointing up

14. a. Removing tool
    b. Cylinder hone
    c. Ring compressor
    d. Spring, springs
    e. Prussian blue
    f. Lap stick
    g. Rubber hose
    h. Grinding

ANSWERS TO TEST

15. a, b, c, d, e, f

16. a. Brittle
    b. Sharp
    c. Lubricating
    d. Compressors
    e. Skirt
    f. Ports
    g. Clips

17. Performance skills evaluated on practical tests